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January 2024

At its meeting on January 26, 2024, the Ohio Board of Building Standards adopted the rule changes identified as Amendments Group 101. These rule amendments were adopted with an <u>effective</u> <u>date of March 1, 2024.</u>

Amendments Group 101 includes amendments to three rules in the Residential Code of Ohio (RCO) as shown below. The complete text of each rule follows this coversheet, and a summary of the significant changes can be found at the end of the rule pages.

Rule Number	RCO Chapter	Chapter Title	Effective date
4101:8-4-01	4	Foundations	March 1, 2024
4101:8-34-01	34	Electrical	March 1, 2024
4101:8-44-01	44	Referenced Standards	March 1, 2024

Reason for Changes: The Board amended the Ohio Administrative Code as follows:

- **4101:8-4-01**: Brings back exceptions for frost protection; and
- 4101:8-34-01: Adopts by reference 2023 NFPA 70 with Ohio modifications; and
- **4101:8-44-01**: Adopts updated referenced editions of selected standards.

The amendments reflect response to petitions #20-11, #21-01, #22-01, the International Residential Code errata, and the Board's own action to update the current Residential Code of Ohio.

Please contact the Board with any questions at (614) 644-2613 or <u>BBS@com.ohio.gov</u>.

4101:8-4-01 Foundations.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:8-44-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:8-1-01 of the Administrative Code.]

SECTION 401 GENERAL

401.1 Application. The provisions of this chapter shall control the design and construction of the foundation and foundation spaces for buildings. In addition to the provisions of this chapter, the design and construction of foundations in flood hazard areas as established by Table 301.2(1) shall meet the provisions of Section 322. Wood foundations shall be designed and installed in accordance with AWC PWF.

Exception: The provisions of this chapter shall be permitted to be used for wood foundations only in the following situations:

- 1. In buildings that have not more than two floors and a roof.
- 2. Where interior basement and foundation walls are constructed at intervals not exceeding 50 feet (15 240 mm).

401.2 Requirements. Foundation construction shall be capable of accommodating all loads in accordance with Section R301 and of transmitting the resulting loads to the supporting soil. Fill soils that support footings and foundations shall be designed, installed and tested in accordance with accepted engineering practice.

401.3 Drainage. Surface drainage shall be diverted to a storm sewer conveyance or other approved point of collection that does not create a hazard. Lots shall be graded to drain surface water away from foundation walls. The grade shall fall not fewer than 6 inches (152 mm) within the first 10 feet (3048 mm).

Exception: Where lot lines, walls, slopes or other physical barriers prohibit 6 inches (152 mm) of fall within 10 feet (3048 mm), drains or swales shall be constructed to ensure drainage away from the structure. Impervious surfaces within 10 feet (3048 mm) of the building foundation shall be sloped not less than 2 percent away from the building.

401.4 Soil tests. Where quantifiable data created by accepted soil science methodologies indicate expansive soils, compressible soils, shifting soils or other

questionable soil characteristics are likely to be present, the building official *may* determine whether to require a soil test to determine the soil's characteristics at a particular location. This test shall be done by an approved agency using an approved method.

401.4.1 Geotechnical evaluation. In lieu of a complete geotechnical evaluation, the load-bearing values in Table 401.4.1 shall be assumed.

TABLE 401.4.1

PRESUMPTIVE LOAD-BEARING VALUES OF FOUNDATION MATERIALS ^a

CLASS OF MATERIAL	LOAD-BEARINGPRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy, silty clay, clayey silt, silt and sandy siltclay (CL, ML, MH and CH)	1,500 ^b

For SI: 1 pound per square foot = 0.0479 kPa.

a. Where soil tests are required by Section 401.4, the allowable bearing capacities of the soil shall be part of the recommendations.

b. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation.

401.4.2 Controlled low-strength material (CLSM). Where footings will bear on controlled low-strength material (CLSM), the CLSM shall comply with the provisions of an approved report. The report shall contain the following:

- 1. Specifications for the preparation of the site prior to placement of CLSM.
- 2. Specifications for the CLSM.
- 3. Laboratory or field test method(s) to be used to determine the compressive strength or bearing capacity of the CLSM.
- 4. Test methods for determining the acceptance of the CLSM in the field.
- 5. Number and frequency of field tests required to determine compliance with Item 4.

401.4.3 Compressible or shifting soil. Instead of a complete geotechnical evaluation, where top or subsoils are compressible or shifting, they shall be removed to a depth and width sufficient to ensure stable moisture content in each active zone and shall not be used as fill or stabilized within each active zone by chemical, dewatering or presaturation.

SECTION 402 MATERIALS

402.1 Wood foundations. Wood foundation systems shall be designed and

installed in accordance with the provisions of this code.

402.1.1 Fasteners. Fasteners used below grade to attach plywood to the exterior side of exterior basement or crawl-space wall studs, or fasteners used in knee wall construction, shall be of Type 304 or 316 stainless steel. Fasteners used above grade to attach plywood and all lumber-to-lumber fasteners except those used in knee wall construction shall be of Type 304 or 316 stainless steel, silicon bronze, copper, hot-dipped galvanized (zinc coated) steel nails, or hot-tumbled galvanized (zinc coated) steel nails. Electro-galvanized steel nails and galvanized (zinc coated) steel staples shall not be permitted.

402.1.2 Wood treatment. Lumber and plywood shall be pressure-preservative treated and dried after treatment in accordance with AWPA U1 (Commodity Specification A, Special Requirement 4.2), and shall bear the label of an accredited agency. Where lumber or plywood is cut or drilled after treatment, the treated surface shall be field treated with copper naphthenate, the concentration of which shall contain not less than 2-percent copper metal, by repeated brushing, dipping or soaking until the wood cannot absorb more preservative.

402.2 Concrete. Concrete shall have a minimum specified compressive strength of f 'c, as shown in Table 402.2. Concrete subject to moderate or severe weathering as indicated in Table 301.2(1) shall be air entrained as specified in Table 402.2. The maximum weight of fly ash, other pozzolans, silica fume, slag or blended cements that is included in concrete mixtures for garage floor slabs and for exterior porches, carport slabs and steps that will be exposed to deicing chemicals shall not exceed the percentages of the total weight of cementitious materials specified in Section 19.3.3.4 of ACI 318. Materials used to produce concrete and testing thereof shall comply with the applicable standards listed in Chapters 19 and 20 of ACI 318 or ACI 332.

402.2.1 Materials for concrete. Materials for concrete shall comply with the requirements of Section 608.5.1.

	MINIMUM SPECIFIED COMPRESSIVE STRENGTH ^a (f ' _c) Weathering Potential ^b							
TYPE OR LOCATION OF CONCRETE CONSTRUCTION								
	Negligible	Moderate	Severe					
Basement walls, foundations and other concrete not exposed to the weather	2,500	2,500	2,500 °					
Basement slabs and interior slabs on grade, except garage floor slabs	2,500	2,500	2,500 °					

 TABLE 402.2

 MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE

	MINIMUM SPECIFIED COMPRESSIVE STRENGTH ^a (f ' _c)						
TYPE OR LOCATION OF CONCRETE CONSTRUCTION	Weathering Potential ^b						
	Negligible	Moderate	Severe				
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	2,500	3,000 ^d	3,000 ^d				
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	2,500	3,000 d, e, f	3,500 ^{d, e, f}				

For SI: 1 pound per square inch = 6.895 kPa.

a. Strength at 28 days psi.

b. See Table 301.2(1) for weathering potential.

- c. Concrete in these locations that is subject to freezing and thawing during construction shall be airentrained concrete in accordance with Footnote d.
- d. Concrete shall be air-entrained. Total air content (percent by volume of concrete) shall be not less than 5 percent or more than 7 percent.
- e. See Section 402.2 for maximum cementitious materials content.
- f. For garage floors with a steel-troweled finish, reduction of the total air content (percent by volume of concrete) to not less than 3 percent is permitted if the specified compressive strength of the concrete is increased to not less than 4,000 psi.

402.3 Precast concrete. Precast concrete foundations shall be designed in accordance with Section 404.5 and shall be installed in accordance with the provisions of this code and the manufacturer's instructions.

402.3.1 Precast concrete foundation materials. Materials used to produce precast concrete foundations shall meet the following requirements.

- 1. All concrete used in the manufacture of precast concrete foundations shall have a minimum compressive strength of 5,000 psi (34 470 kPa) at 28 days. Concrete exposed to a freezing and thawing environment shall be air entrained with a minimum total air content of 5 percent.
- Structural reinforcing steel shall meet the requirements of ASTM A615, A706 or A996. The minimum yield strength of reinforcing steel shall be 40,000 psi (Grade 40) (276 MPa). Steel reinforcement for pre- cast concrete foundation walls shall have a minimum concrete cover of ³/₄inch (19.1 mm).
- 3. Panel-to-panel connections shall be made with Grade II steel fasteners.
- 4. The use of nonstructural fibers shall conform to ASTM C1116.
- 5. Grout used for bedding precast foundations placed on concrete footings shall meet ASTM C1107.

402.4 Masonry. Masonry systems shall be designed and installed in accordance with this chapter and shall have a minimum specified compressive strength of 1,500 psi (10.3 MPa).

SECTION 403

FOOTINGS

403.1 General. All exterior walls shall be supported on continuous solid or fully grouted masonry or concrete footings, crushed stone footings, wood foundations, or other approved structural systems that shall be of sufficient design to accommodate all loads according to Section 301 and to transmit the resulting loads to the soil within the limitations as determined from the character of the soil. Footings shall be designed and constructed in accordance with the provisions of Section 403 or in accordance with ACI 332.

403.1.1 Minimum size. The minimum width, W, and thickness, T, for concrete footings shall be in accordance with Tables 403.1(1) through 403.1(3) and Figure 403.1(1) or 403.1.3, as applicable. The footing width shall be based on the load-bearing value of the soil in accordance with Table 401.4.1. Footing projections, P, shall be not less than 2 inches (51 mm) and shall not exceed the thickness of the footing. Footing thickness and projection for fireplaces shall be in accordance with Section 1001.2. The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table 401.4.1. Footings for wood foundations shall be in accordance with the details set forth in Section 403.2, and Figures 403.1(2) and 403.1(3). Footings for precast foundations shall be in accordance with the details set forth in Section 403.4, and Figures 403.4(1) and 403.4(2).

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01:8-4-01		
		TABLE 4
MINIMUM WIDTH AND	THICKNESS FOR	CONCRETE FOO

MINIMUM	TABLE 403.1(1) MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION (inches) ^{a, b}									
SNOW LOAD	STORY AND TYPE OF		L	OAD-BEARING	VALUE OF SO	IL				
OR ROOF LIVE LOAD	STRUCTURE WITH LIGHT FRAME	1500	2000	(p 2500	3000	3500	4000			
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-with crawl space	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story—plus basement	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	2 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
) psf	2 story-with crawl space	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
2(2 story-plus basement	22 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6			
	3 story—slab-on-grade	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—with crawl space	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—plus basement	25 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6			
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-with crawl space	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story—plus basement	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
J	2 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
0 ps	2 story—with crawl space	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
ñ	2 story—plus basement	23 x 6	17 x 6	14 x 6	12 x 6	12 x 6	12 x 6			
	3 story—slab-on-grade	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—with crawl space	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—plus basement	26 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6			
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-with crawl space	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-plus basement	21 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6			
Ŧ	2 story—slab-on-grade	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
0 ps	2 story—with crawl space	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
L. C.	2 story-plus basement	25 x 7	19 x 6	15 x 6	12 x 6	12 x 6	12 x 6			
	3 story—slab-on-grade	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—with crawl space	22 x 6	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6			
	3 story—plus basement	28 x 9	21 x 6	17 x 6	14 x 6	12 x 6	12 x 6			
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-with crawl space	18 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	1 story-plus basement	24 x 7	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6			
f	2 story—slab-on-grade	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
sd 0,	2 story—with crawl space	21 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6			
Ľ	2 story—plus basement	27 x 9	20 x 6	16 x 6	14 x 6	12 x 6	12 x 6			
	3 story—slab-on-grade	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6			
	3 story—with crawl space	25 x 7	18 x 6	15 x 6	12 x 6	12 x 6	12 x 6			
	3 story—plus basement	30 x 10	23 x 6	18 x 6	15 x 6	12 x 6	12 x 6			

For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m, 1 pound per square foot = 47.9 N/m².

a. Interpolation allowed. Extrapolation is not allowed.

b. Based on 32-foot-wide house with load-bearing center wall that carries half of the tributary attic, and floor framing. For every 2 feet of adjustment to the width of the house, add or subtract 2 inches of footing width and 1 inch of footing thickness (but not less than 6 inches thick).



TABLE 403.1(2) MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION WITH BRICK VENEER (inches) ^{a, b}

SNOW	STORY AND TYPE OF		L	OAD-BEARING (p	VALUE OF SO	ГL	
ROOF LIVE	BRICK VENEER	1500	2000	2500	3000	3500	4000
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-with crawl space	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-plus basement	21 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
ч	2 story—slab-on-grade	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
sd 0;	2 story—with crawl space	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
5	2 story—plus basement	26 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6
	3 story—slab-on-grade	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	3 story—with crawl space	26 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6
	3 story—plus basement	32 x 11	24 x 7	19 x 6	16 x 6	14 x 6	12 x 6
	1 story—slab-on-grade	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-with crawl space	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—plus basement	22 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6
مب	2 story—slab-on-grade	16 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
sd 0	2 story—with crawl space	22 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6
с о	2 story—plus basement	27 x 9	21 x 6	16 x 6	14 x 6	12 x 6	12 x 6
	3 story—slab-on-grade	21 x 6	16 x 6	13 x 6	12 x 6	12 x 6	12 x 6
	3 story—with crawl space	27 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6
	3 story—plus basement	33 x 11	24 x 7	20 x 6	16 x 6	14 x 6	12 x 6
	1 story—slab-on-grade	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-with crawl space	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-plus basement	24 x 7	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6
44	2 story—slab-on-grade	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6
sd 0g	2 story-with crawl space	24 x 7	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6
νC)	2 story—plus basement	29 x 10	22 x 6	18 x 6	15 x 6	13 x 6	12 x 6
	3 story—slab-on-grade	27 x 7	18 x 6	13 x 6	12 x 6	12 x 6	12 x 6
	3 story—with crawl space	29 x 9	22 x 6	17 x 6	14 x 6	12 x 6	12 x 6
	3 story—plus basement	35 x 12	26 x 8	21 x 6	17 x 6	15 x 6	13 x 6
	1 story—slab-on-grade	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story-with crawl space	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
	1 story—plus basement	26 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6
44	2 story—slab-on grade	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6
sd 0,	2 story—with crawl space	26 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6
L L	2 story—plus basement	32 x 11	24 x 7	19 x 6	16 x 6	14 x 6	12 x 6
	3 story—slab-on-grade	26 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6
	3 story—with crawl space	31 x 11	23 x 7	19 x 6	16 x 6	13 x 6	12 x 6
	3 story—plus basement	37 x 13	28 x 9	22 x 6	18 x 6	16 x 6	14 x 6

For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m, 1 pound per square foot = 47.9 N/m^2 .

a. Interpolation allowed. Extrapolation is not allowed.

Based on 32-foot-wide house with load-bearing center wall that carries half of the tributary attic, and floor framing. For every 2 feet
of adjustment to the width of the house, add or subtract 2 inches of footing width and 1 inch of footing thickness (but not less than 6
inches thick).



TABLE 403.1(3) MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS WITH CAST-IN-PLACE CONCRETE OR FULLY GROUTED MASONRY WALL CONSTRUCTION (inches)^{a, b}

SNOW LOAD	STORY AND TYPE OF	LOAD-BEARING VALUE OF SOIL (psf)									
LIVE LOAD	STRUCTURE WITH CMU	1500	2000	2500	3000	3500	4000				
	1 story—slab-on-grade	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—with crawl space	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—plus basement	25 x 8	19 x 6	15 x 6	13 x 6	12 x 6	12 x 6				
4	2 story—slab-on-grade	23 x 7	18 x 6	14 x 6	12 x 6	12 x 6	12 x 6				
o ps	2 story—with crawl space	29 x 9	22 x 6	17 x 6	14 x 6	12 x 6	12 x 6				
5	2 story—plus basement	35 x 12	26 x 8	21 x 6	17 x 6	15 x 6	13 x 6				
	3 story—slab-on-grade	32 x 11	24 x 7	19 x 6	16 x 6	14 x 6	12 x 6				
	3 story—with crawl space	38 x 14	28 x 9	23 x 6	19 x 6	16 x 6	14 x 6				
	3 story—plus basement	43 x 17	33 x 11	26 x 8	22 x 6	19 x 6	16 x 6				
	1 story—slab-on-grade	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—with crawl space	20 x 6	15 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—plus basement	26 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6				
f	2 story—slab-on-grade	24 x 7	18 x 6	15 x 6	12 x 6	12 x 6	12 x 6				
o ps	2 story—with crawl space	30 x 10	22 x 6	18 x 6	15 x 6	13 x 6	12 x 6				
ñ	2 story—plus basement	36 x 13	27 x 8	21 🗆 6	18 x 6	15 x 6	13 x 6				
	3 story—slab-on-grade	33 x 12	25 x 7	20 x 6	17 x 6	14 x 6	12 x 6				
	3 story—with crawl space	39 x 14	29 x 9	23 x 7	19 x 6	17 x 6	14 x 6				
	3 story—plus basement	44 x 17	33 x 12	27x 8	22 x 6	19 x 6	17 x 6				
	1 story—slab-on-grade	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—with crawl space	22 x 6	17 x 6	13 x 6	12 x 6	12 x 6	12 x 6				
	1 story—plus basement	28x 9	21 x 6	17 x 6	14 x 6	12 x 6	12 x 6				
f	2 story—slab-on-grade	27 x 8	20 x 6	16 x 6	13 x 6	12 x 6	12 x 6				
sd 0	2 story—with crawl space	32 x 11	24 x 7	19 x 6	16 x 6	14 x 6	12 x 6				
5	2 story—plus basement	38 x 14	28 x 9	23 x 6	19 x 6	16 x 6	14 x 6				
	3 story—slab-on-grade	35 x 13	27 x 8	21 x 6	18 x 6	15 x 6	13 x 6				
	3 story—with crawl space	41 x 15	31 x 10	24 x 7	20 x 6	17 x 6	15 x 6				
	3 story—plus basement	47 x 18	35 x 12	28 x 9	23 x 7	20 x 6	17 x 6				
	1 story—slab-on-grade	19 x 6	14 x 6	12 x 6	12 x 6	12 x 6	12 x 6				
	1 story—with crawl space	25 x 7	18 x 6	15 x 6	12 x 6	12 x 6	12 x 6				
	1 story—plus basement	30 x 10	23 x 6	18 x 6	15 x 6	13 x 6	12 x 6				
f	2 story—slab-on-grade	29 x 9	22 x 6	17 x 6	14 x 6	12 x 6	12 x 6				
0 ps	2 story—with crawl space	34 x 12	26 x 8	21 x 6	17 x 6	15 x 6	13 x 6				
L	2 story—plus basement	40 x 15	30 x 10	24 x 7	20 x 6	17 x 6	15 x 6				
	3 story—slab-on-grade	38 x 14	28 x 9	23 x 6	19 x 6	16 x 6	14 x 6				
	3 story—with crawl space	43 x 16	32 x 11	26 x 8	21 x 6	18 x 6	16 x 6				
	3 story—plus basement	49 x 19	37 x 13	29 x 10	24 x 7	21 x 6	18 x 6				

For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m, 1 pound per square foot = 47.9 N/m^2 .

a. Interpolation allowed. Extrapolation is not allowed.

b. Based on 32-foot-wide house with load-bearing center wall that carries half of the tributary attic, and floor framing. For every 2 feet of adjustment to the width of the house add or subtract 2 inches of footing width and 1 inch of footing thickness (but not less than 6 inches thick).





For SI: 1 inch = 25.4 mm.

W = Width of footing, T = Thickness of footing and P = Projection per Section 403.1.1 **NOTES:**

- a. See Section 404.3 for sill requirements.
- b. See Section 403.1.6 for sill attachment.
- c. See Section 506.2.3 for vapor barrier requirements.
- d. See Section 403.1 for base.
- e. Deleted
- f. See Section 408 for under-floor ventilation and access requirements.

FIGURE 403.1(1) PLAIN CONCRETE FOOTINGS WITH MASONRY AND CONCRETE STEM WALLS IN SDC A, B and C ^{a, b, c, d, e, f}



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mil = 0.0254.

FIGURE 403.1(2) PERMANENT WOOD FOUNDATION BASEMENT WALL SECTION



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 mil = 0.0254 mm.

FIGURE 403.1(3) PERMANENT WOOD FOUNDATION CRAWL SPACE SECTION

403.1.2 Continuous footing in Seismic Design Categories D_0 , D_1 and D_2 . *Deleted*

403.1.3 Footing and stem wall reinforcing in Seismic Design Categories D₀, D₁, and D₂. *Deleted*

403.1.3.1 Concrete stem walls with concrete footings. Deleted

403.1.3.2 Masonry stem walls with concrete footings. Deleted

403.1.3.3 Slabs-on-ground with turned-down footings. Deleted

403.1.3.4 Interior bearing and braced wall panel (1219 mm) footings in Seismic Design Categories D₀, D₁ and D₂. *Deleted*

403.1.3.5 Reinforcement. Deleted

403.1.3.5.1 Steel reinforcement. Deleted

403.1.3.5.2 Location of reinforcement in wall. Deleted

403.1.3.5.3 Support and cover. Deleted

403.1.3.5.4 Lap splices. Deleted

403.1.3.6 Isolated concrete footings. Deleted

Deleted figure

FIGURE 403.1.3 REINFORCED CONCRETE FOOTINGS AND MASONRY AND CONCRETE STEM WALLS IN SDC D₀, D₁ AND D₂^{a, b, c, d, e, f}

403.1.4 Minimum depth. Exterior footings shall be placed not less than 12 inches (305 mm) below the undisturbed ground surface. Where applicable, the depth of footings shall also conform to Sections 403.1.4.1.

403.1.4.1 Frost protection. Except where otherwise protected from frost, foundation walls, piers and other permanent supports of buildings and structures shall be protected from frost by one or more of the following methods:

- 1. Extended below the frost line specified in Table 301.2(1).
- 2. Constructed in accordance with Section 403.3.
- 3. Constructed in accordance with ASCE 32.
- 4. Erected on solid rock.

Footings shall not bear on frozen soil unless the frozen condition is permanent that extend below the frost line.

Exceptions:

- 1. *Deleted* Protection of freestanding accessory structures with an area of 600 square feet (56 m²) or less, of light-frame construction, with an eave height of 10 feet (3048 mm) or less is not required.
- 2. Deleted Protection of freestanding accessory structures with an area of 400 square feet (37 m²) or less, of other than light-frame construction, with an eave height of 10 feet (3048 mm) or less is not required.
- 3. Decks not supported by a dwelling need not be provided with footings that extend below the frost line.

403.1.5 Slope. The top surface of footings shall be level. The bottom surface of footings shall not have a slope exceeding one unit vertical in 10 units horizontal (10-percent slope). Footings shall be stepped where it is necessary to change the elevation of the top surface of the footings or where the slope of the bottom surface of the footings will exceed one unit vertical in 10 units horizontal (10-percent slope).

403.1.6 Foundation anchorage. Wood sill plates and wood walls supported directly on continuous foundations shall be anchored to the foundation in accordance with this section.

Cold-formed steel framing shall be anchored directly to the foundation or fastened to wood sill plates in accordance with Section 505.3.1 or 603.3.1, as applicable. Wood sill plates supporting cold-formed steel framing shall be anchored to the foundation in accordance with this section.

Wood sole plates at all exterior walls on monolithic slabs, wood sole plates of braced wall panels at building interiors on monolithic slabs and all wood sill plates shall be anchored to the foundation with minimum 1/2 -inch diameter (12.7 mm) anchor bolts spaced not greater than 6 feet (1829 mm) on center or approved anchors or anchor straps spaced as required to provide equivalent anchorage to 1/2 -inch diameter (12.7 mm) anchor bolts. Bolts shall extend not less than 7 inches (178 mm) into concrete or grouted cells of concrete masonry units. A nut and washer shall be tightened on each anchor bolt. There shall be not fewer than two bolts per plate section with one bolt located not more than 12 inches (305 mm) or less than seven bolt diameters from each end of the plate section. Interior bearing wall sole plates on monolithic slab foundation that are not part of a braced wall panel shall be positively anchored with approved fasteners. Sill plates and sole plates shall be protected against decay and termites where required by Sections 317 and 318.

Exceptions:

- 1. Walls 24 inches (610 mm) total length or shorter connecting offset braced wall panels shall be anchored to the foundation with not fewer than one anchor bolt located in the center third of the plate section and shall be attached to adjacent braced wall panels at corners as shown in Item 9 of Table 602.3(1).
- 2. Connection of walls 12 inches (305 mm) total length or shorter connecting offset braced wall panels to the foundation without anchor bolts shall be permitted. The wall shall be attached to adjacent braced wall panels at corners as shown in Item 9 of Table 602.3(1).

403.1.6.1 Foundation anchorage in Seismic Design Categories *C***.** In addition to the requirements of Section 403.1.6, the following requirements shall apply to wood light-frame *dwellings with four or more dwelling units* in Seismic Design Categories *C*:

- 1. Plate washers conforming to Section 602.11.1 shall be provided for all anchor bolts over the full length of required braced wall lines except where approved anchor straps are used. Properly sized cut washers shall be permitted for anchor bolts in wall lines not containing braced wall panels.
- Interior braced wall plates shall have anchor bolts spaced at not more than 6 feet (1829 mm) on center and located within 12 inches (305 mm) of the ends of each plate section where supported on a continuous foundation.
- 3. Interior bearing wall sole plates shall have anchor bolts spaced at not more than 6 feet (1829 mm) on center and located within 12 inches (305 mm) of the ends of each plate section where supported on a continuous foundation.
- 4. The maximum anchor bolt spacing shall be 4 feet (1219 mm) for buildings over two stories in height.
- 5. Stepped cripple walls shall conform to Section 602.11.2.
- 6. Where continuous wood foundations in accordance with Section 404.2 are used, the force transfer shall have a capacity equal to or greater than the connections required by Section 602.11.1 or the braced wall panel shall be connected to the wood foundations in accordance with the braced wall panel-to-floor fastening requirements of Table 602.3(1).

403.1.7 Footings on or adjacent to slopes. The placement of buildings and structures on or adjacent to slopes steeper than one unit vertical in three units horizontal (33.3-percent slope) shall conform to Sections 403.1.7.1 through

403.1.7.4.

403.1.7.1 Building clearances from ascending slopes. In general, buildings below slopes shall be set a sufficient distance from the slope to provide protection from slope drainage, erosion and shallow failures. Except as provided in Section 403.1.7.4 and Figure 403.1.7.1, the following criteria will be assumed to provide this protection. Where the existing slope is steeper than one unit vertical in one unit horizontal (100-percent slope), the toe of the slope shall be assumed to be at the intersection of a horizontal plane drawn from the top of the foundation and a plane drawn tangent to the slope at an angle of 45 degrees (0.79 rad) to the horizontal. Where a retaining wall is constructed at the top of the slope, the height of the slope shall be measured from the top of the wall to the top of the slope.



For SI: 1 foot = 304.8 mm.

FIGURE 403.1.7.1 FOUNDATION CLEARANCE FROM SLOPES

403.1.7.2 Footing setback from descending slope surfaces. Footings on or adjacent to slope surfaces shall be founded in material with an embedment and setback from the slope surface sufficient to provide vertical and lateral support for the footing without detrimental settlement. Except as provided for in Section 403.1.7.4 and Figure 403.1.7.1, the following setback is deemed adequate to meet the criteria. Where the slope is steeper than one unit vertical in one unit horizontal (100-percent slope), the required setback shall be measured from an imaginary plane 45 degrees (0.79 rad) to the horizontal, projected upward from the toe of the slope.

403.1.7.3 Foundation elevation. On graded sites, the top of any exterior foundation shall extend above the elevation of the street gutter at point of discharge or the inlet of an approved drainage device not less than 12 inches (305 mm) plus 2 percent. Alternate elevations are permitted subject to the

approval of the building official, provided that it can be demonstrated that required drainage to the point of discharge and away from the structure is provided at all locations on the site.

403.1.7.4 Alternate setbacks and clearances. Alternate setbacks and clearances are permitted, subject to the approval of the building official. The building official is permitted to require an investigation and recommendation of a qualified engineer to demonstrate that the intent of this section has been satisfied. Such an investigation shall include consideration of material, height of slope, slope gradient, load intensity and erosion characteristics of slope material.

403.1.8 Foundations on expansive soils. Foundation and floor slabs for buildings located on expansive soils shall be designed in accordance with Section 1808.6 of the *Ohio building code*.

Exception: Slab-on-ground and other foundation systems that have performed adequately in soil conditions similar to those encountered at the building site are permitted subject to the approval of the building official.

403.1.8.1 Expansive soils classifications. Soils meeting all of the following provisions shall be considered to be expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:

- 1. Plasticity Index (*PI*) of 15 or greater, determined in accordance with ASTM D4318.
- 2. More than 10 percent of the soil particles pass a No. 200 sieve (75 μ m), determined in accordance with ASTM D422.
- 3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D422.
- 4. Expansion Index greater than 20, determined in accordance with ASTM D4829.

403.2 Footings for wood foundations. Footings for wood foundations shall be in accordance with Figures 403.1(2) and 403.1(3). Gravel shall be washed and well graded. The maximum size stone shall not exceed ${}^{3}/_{4}$ -inch (19.1 mm). Gravel shall be free from organic, clayey or silty soils. Sand shall be coarse, not smaller than ${}^{1}/_{16}$ -inch (1.6 mm) grains and shall be free from organic, clayey or silty soils. Crushed stone shall have a maximum size of ${}^{1}/_{2}$ -inch (12.7 mm)

403.3 Frost-protected shallow foundations. For buildings where the monthly mean temperature of the building is maintained at not less than 64°F (18°C),

footings are not required to extend below the frost line where protected from frost by insulation in accordance with Figure 403.3(1) and Table 403.3(1). Foundations protected from frost in accordance with Figure 403.3(1) and Table 403.3(1) shall not be used for unheated spaces such as porches, utility rooms, garages and carports, and shall not be attached to basements or crawl spaces that are not maintained at a minimum monthly mean temperature of $64^{\circ}F$ ($18^{\circ}C$).

Materials used below grade for the purpose of insulating footings against frost shall be labeled as complying with ASTM C578.

403.3.1 Foundations adjoining frost-protected shallow foundations. Foundations that adjoin frost-protected shallow foundations shall be protected from frost in accordance with Section 403.1.4.

403.3.1.1 Attachment to unheated slab-on-ground structure. Vertical wall insulation and horizontal insulation of frost-protected shallow foundations that adjoin a slab-on-ground foundation that does not have a monthly mean temperature maintained at not less than 64°F (18°C) shall be in accordance with Figure 403.3(3) and Table 403.3(1). Vertical wall insulation shall extend between the frost-protected shallow foundation and the adjoining slab foundation. Required horizontal insulation shall be continuous under the adjoining slab foundation and through any foundation walls adjoining the frost-protected shallow foundation. Where insulation passes through a foundation wall, it shall be either of a type complying with this section and having bearing capacity equal to or greater than the structural loads imposed by the building, or the building shall be designed and constructed using beams, lintels, cantilevers or other means of transferring building loads such that the structural loads of the building do not bear on the insulation.

403.3.1.2 Attachment to heated structure. Where a frost-protected shallow foundation abuts a structure that has a monthly mean temperature maintained at not less than $64^{\circ}F$ ($18^{\circ}C$), horizontal insulation and vertical wall insulation shall not be required between the frost-protected shallow foundation and the adjoining structure. Where the frost-protected shallow foundation abuts the heated structure, the horizontal insulation and vertical wall insulation shall extend along the adjoining foundation in accordance with Figure 403.3(4) a distance of not less than Dimension A in Table 403.3(1).

Exception: Where the frost-protected shallow foundation abuts the heated structure to form an inside corner, vertical insulation extending along the adjoining foundation is not required.

403.3.2 Protection of horizontal insulation below ground. Horizontal insulation placed less than 12 inches (305 mm) below the ground surface or that portion of horizontal insulation extending outward more than 24 inches (610 mm) from the foundation edge shall be protected against damage by use of a concrete slab or asphalt paving on the ground surface directly above the insulation or by cementitious board, plywood rated for below-ground use, or other approved materials placed below ground, directly above the top surface of the insulation.

403.3.3 Drainage. Final grade shall be sloped in accordance with Section 401.3. In other than Group I Soils, as detailed in Table 405.1, gravel or crushed stone beneath horizontal insulation below ground shall drain by gravity or mechanical means into an approved drainage system or other location that complies with the plumbing code.

403.3.4 Termite protection. The use of foam plastic in areas of "very heavy" termite infestation probability shall be in accordance with Section 318.4.

TABLE 403.3(1) MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS ^a

AIR FREEZING INDEX	MINIMUM FOOTING DEPTH,	VERTICAL INSULATION	HORIZONTAL R-VAI	INSULATION LUE ^{c, e}	HORIZONTAL INSULATION DIMENSIONS PER FIGURE 403.3(1) (inches)			
(°F-days) ^b	D	R-VALUE ^{c, d}	Along walls	At corners	Α	В	С	
1,500 or less	12	4.5	Not required	Not required	Not required	Not required	Not required	
2,000	14	5.6	Not required	Not required	Not required	Not required	Not required	

For SI: 1 inch = 25.4 mm, $^{\circ}C = [(^{\circ}F) - 32]/1.8$.

a. Insulation requirements are for protection against frost damage in heated buildings. Greater values could be required to meet energy conservation standards.

b. See Figure 403.3(2) or Table 403.3(2) for Air Freezing Index values.

c. Insulation materials shall provide the stated minimum *R*-values under long-term exposure to moist, below-ground conditions in freezing climates. The following *R*-values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene (EPS)-3.2 R per inch for vertical insulation and 2.6 R per inch for horizontal insulation; Type IX expanded polystyrene (EPS)-3.4 R per inch for vertical insulation and 2.8 R per inch for horizontal insulation; Types IV, V, VI, VII, and X extruded polystyrene (XPS)-4.5 R per inch for vertical insulation and 4.0 R per inch for horizontal insulation.

d. Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.

e. Horizontal insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.



For SI: 1 inch = 25.4 mm.

a. See Table 403.3(1) for required dimensions and *R*-values for vertical and horizontal insulation and minimum footing depth.

FIGURE 403.3(1) INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS



For SI: $^{\circ}C = [(^{\circ}F) - 32]/1.8$.

Note: The air-freezing index is defined as cumulative degree days below 32°F. It is used as a measure of the combined magnitude and duration of air temperature below freezing. The index was computed over a 12-month period (July-June) for each of the 3,044 stations used in the above analysis. Dates from the 1951-80 period were fitted to a Weibull probability distribution to produce an estimate of the 100-year return period.

FIGURE 403.3(2) AIR-FREEZING INDEX AN ESTIMATE OF THE 100-YEAR RETURN PERIOD

TABLE 403.3(2) AIR-FREEZING INDEX FOR U.S. LOCATIONS BY COUNTY AIR ERFEZINC INDEX

STATE		AIR-FREEZING INDEA								
SIAIE	ATE 1500 or less 2000		2500	3000	3500	4000				
Ohio	All counties not listed	Ashland, Crawford, Defiance, Holmes, Huron, Knox, Licking, Morrow, Paulding, Putnam, Richland, Seneca, Williams	_							

INSULATION DETAIL



HORIZONTAL INSULATION PLAN





1. See Table 403.3(1) for required dimensions and *R*-values for vertical and horizontal insulation.

FIGURE 403.3(3) INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS ADJACENT TO UNHEATED SLAB-ON-GROUND STRUCTURE



FIGURE 403.3(4) INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS ADJACENT TO HEATED STRUCTURE

			M DE	1 1 11	(D) A		111(//	$\mathbf{)}\mathbf{Or}$	LUS	псD	510			IIIGS) (I	nenes)			
								LOA	AD-BEA	ARING	VALU	JE OF SOIL (psf)								
NUMBER	UNIFORM	DEPTH (D)		1500			2000			2500			3000			3500			4000	
OF	WALL	AND	MH, CH, CL, ML ^c		SC, GC, SI	M, GM, S	SP, SW °				G	P, GW	с							
STORIES	LOAD	WIDTH (W)	Wall w	width (i	nches)	Wall w	Wall width (inches) W		Wall v	vidth (i	nches)	Wall v	vidth (i	nches)	Wall w	vidth (i	nches)	Wall width (inches)		
			8	10	12	8	10	12	8	10	12	8	10	12	8	10	12	8	10	12
					1	Cor	iventional	light-fra	me const	ruction								1		
1-story	1100 plf	D	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
J	1	W	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17
2-story	1800 plf	D	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2-3t01y	1000 pii	W	15	15	17	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17
3 story	2000 plf	D	14	12	10	9	7	5	6	4	4	4	4	4	4	4	4	4	4	4
5-story 2900 pi	W	25	24	24	19	19	18	15	15	17	13	15	17	13	15	17	13	15	17	
		·			4-inch b	orick veneer o	over light-	frame or	8-inch h	ollow co	ncrete n	nasonry								
1_story	1500 plf	D	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
1-story	1500 pii	W	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17
2-story	2700 plf	D	12	11	9	8	6	4	5	4	4	4	4	4	4	4	4	4	4	4
2-story	2700 pii	W	22	23	23	18	17	17	14	15	17	13	15	17	13	15	17	13	15	17
3 story	4000 plf	D	21	20	18	14	13	11	10	8	7	7	6	4	5	4	4	4	4	4
5-8101y	4000 pii	W	33	34	33	25	26	25	20	20	21	17	17	17	14	15	17	13	15	17
						8-iı	nch solid o	or fully gr	outed m	asonry										
1-story	2000 plf	D	7	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
1-3t01y	2000 pii	W	17	17	17	13	15	17	13	15	17	13	15	17	13	15	17	13	15	17
2-story	3600 plf	D	19	17	15	12	11	9	9	7	5	6	4	4	4	4	4	4	4	4
2-story	5000 pii	W	30	30	30	22	23	23	19	19	18	15	15	17	13	15	17	13	15	17
3 story	5300 plf	D	30	29	27	21	19	18	16	14	12	12	10	8	9	8	6	7	6	4
3-801y	5500 pi	W	43	44	44	33	32	33	27	27	26	22	22	22	19	20	19	17	17	17

 TABLE 403.4

 MINIMUM DEPTH (D) AND WIDTH (W) OF CRUSHED STONE FOOTINGS ^{a, b} (inches)

 W
 43
 44
 44
 33
 32
 32

 For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m, 1 pound per square foot = 47.9 N/m².

a. Linear interpolation of stone depth between wall widths is permitted within each Load-Bearing Value of Soil (psf).

b. Crushed stone must be consolidated in 8-inch lifts with a plate vibrator.

403.4 Footings for precast concrete foundations. Footings for precast concrete foundations shall comply with Section 403.4.

403.4.1 Crushed stone footings. Clean crushed stone shall be free from organic, clayey or silty soils. Crushed stone shall be angular in nature and meet ASTM C33, with the maximum size stone not to exceed 1/2 -inch (12.7 mm) and the minimum stone size not to be smaller than 1/16 -inch (1.6 mm). Crushed stone footings for precast foundations shall be installed in accordance with Figure 403.4(1) and Table 403.4. Crushed stone footings shall be consolidated using a vibratory plate in not greater than 8-inch (203 mm) lifts. Crushed stone footings shall be limited to Seismic Design Categories A, B and C.

403.4.2 Concrete footings. Concrete footings shall be installed in accordance with Section 403.1 and Figure 403.4(2).



FIGURE 403.4(1) BASEMENT OR CRAWL SPACE WITH PRECAST FOUNDATION WALL BEARING ON CRUSHED STONE



FIGURE 403.4(2) BASEMENT OR CRAWL SPACE WITH PRECAST FOUNDATION WALL ON SPREAD FOOTING

403.5 Exterior deck footings. See Section 507 for exterior deck foundation requirements.

SECTION 404 FOUNDATION AND RETAINING WALLS

404.1 Concrete and masonry foundation walls. Concrete foundation walls shall be selected and constructed in accordance with the provisions of Section 404.1.3. Masonry foundation walls shall be selected and constructed in accordance with the provisions of Section 404.1.2.

404.1.1 Design required. Concrete or masonry foundation walls shall be designed in accordance with accepted engineering practice where either of the following conditions exists:

- 1. Walls are subject to hydrostatic pressure from ground water.
- 2. Walls supporting more than 48 inches (1219 mm) of unbalanced backfill that do not have permanent lateral support at the top or bottom.

MAXIMUM WALL	MAXIMUM UNBALANCED	PLAIN MASONRY ^a MINIMUM NOMINAL WALL THICKNESS (inches)							
HEIGHT	BACKFILL	Soil classes ^b							
(feet)	(feet)	GW, GP, SW and SP	GM, GC, SM, SM- SC and ML	SC, MH, ML-CL and inorganic CL					
5	4	6 solid ^d or 8	6 solid ^d or 8	6 solid ^d or 8					
5	5	6 solid ^d or 8	8	10					
	4	6 solid ^d or 8	6 solid ^d or 8	6 solid ^d or 8					
6	5	6 solid ^d or 8	8	10					
	6	8	10	12					
7	4	6 solid ^d or 8	8	8					
	5	6 solid ^d or 8	10	10					
/	6	10	12	10 solid ^d					
	7	12	10 solid ^d	12 solid ^d					
	4	6 solid ^d or 8	6 solid ^d or 8	8					
	5	6 solid ^d or 8	10	12					
8	6	10	12	12 solid ^d					
	7	12	12 solid ^d	Footnote e					
	8	10 grout ^d	12 grout ^d	Footnote e					
	4	6 grout ^d or 8	6 grout ^d or 8	8 grout ^d or 10					
	5	6 grout ^d or 10	8 grout ^d or 12	8 grout ^d					
0	6	8 grout ^d or 12	10 grout ^d	10 grout ^d					
9	7	solid ^d	10 grout ^d	12 grout					
	8	10 grout ^d	12 grout	Footnote ^e					
	9	12 grout	Footnote e	Footnote ^e					

TABLE 404.1.1(1)PLAIN MASONRY FOUNDATION WALLS f

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 Pa.

- b. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table 405.1.
- c. Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with the interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.
- d. Solid indicates solid masonry unit; grout indicates grouted hollow units.
- e. Wall construction shall be in accordance with either Table 404.1.1(2), Table 404.1.1(3), Table 404.1.1(4), or a design shall be provided.
- f. The use of this table shall be prohibited for soil classifications not shown.

a. Mortar shall be Type M or S and masonry shall be laid in running bond. Ungrouted hollow masonry units are permitted except where otherwise indicated.

MINIMUM VERTICAL REINFORCEMENT AND SPACING (INCHES) ^{b, c}					
	HEIGHT OF	Soil classes and lateral soil load ^d (nsf per foot below grade)			
WALL HEIGHT	UNBALANCED BACKFILL ^e	GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, ML-CL and inorganic CL soils 60	
6 feet 8 inches	4 feet (or less) 5 feet 6 feet 8 inches	#4 at 48 #4 at 48 #4 at 48	#4 at 48 #4 at 48 #5 at 48	#4 at 48 #4 at 48 #6 at 48	
7 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 4 inches	#4 at 48 #4 at 48 #4 at 48 #5 at 48	#4 at 48 #4 at 48 #5 at 48 #6 at 48	#4 at 48 #4 at 48 #5 at 48 #6 at 40	
8 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet	#4 at 48 #4 at 48 #4 at 48 #5 at 48 #5 at 48	#4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 48	#4 at 48 #4 at 48 #5 at 48 #6 at 40 #6 at 32	
8 feet 8 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 8 inches	#4 at 48 #4 at 48 #4 at 48 #5 at 48 #6 at 48	#4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 32	#4 at 48 #5 at 48 #6 at 48 #6 at 40 #6 at 24	
9 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 4 inches	#4 at 48 #4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 40	#4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 40 #6 at 24	#4 at 48 #5 at 48 #6 at 48 #6 at 40 #6 at 24 #6 at 16	
10 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 10 feet	#4 at 48 #4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 40 #6 at 32	#4 at 48 #4 at 48 #5 at 48 #6 at 48 #6 at 32 #6 at 24 #6 at 16	#4 at 48 #5 at 48 #6 at 48 #6 at 32 #6 at 24 #6 at 16 #6 at 16	

TABLE 404.1.1(2)8-INCH MASONRY FOUNDATION WALLS WITH
REINFORCING WHERE $d \ge 5$ INCHES a, c, f

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/mm.

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches in Seismic Design Categories A, B and C.

- c. Vertical reinforcement shall be Grade 60 minimum. The distance, *d*, from the face of the soil side of the wall to the center of vertical reinforcement shall be not less than 5 inches.
- d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. Refer to Table 405.1.
- e. Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with the interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.

f. The use of this table shall be prohibited for soil classifications not shown.

REINFORCING WHERE $d \ge 6.75$ INCHES ^{a, c, t}						
		MINIMUM VERTICAI	REINFORCEMENT AND S	SPACING (INCHES) ^{b, c}		
3 37 A T T	HEIGHT OF	Soil classes and later soil load ^d (psf per foot below grade)				
WALL HEIGHT	UNBALANCED BACKFILL ^e	GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, ML-CL and inorganic CL soils 60		
6 feet 8 inches	4 feet (or less) 5 feet 6 feet 8 inches	#4 at 56 #4 at 56 #4 at 56	#4 at 56 #4 at 56 #5 at 56	#4 at 56 #4 at 56 #5 at 56		
7 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 4 inches	#4 at 56 #4 at 56 #4 at 56 #4 at 56	#4 at 56 #4 at 56 #4 at 56 #5 at 56	#4 at 56 #4 at 56 #5 at 56 #6 at 56		
8 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet	#4 at 56 #4 at 56 #4 at 56 #4 at 56 #5 at 56	#4 at 56 #4 at 56 #4 at 56 #5 at 56 #6 at 56	#4 at 56 #4 at 56 #5 at 56 #6 at 56 #6 at 48		
8 feet 8 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 8 inches	#4 at 56 #4 at 56 #4 at 56 #4 at 56 #5 at 56	#4 at 56 #4 at 56 #4 at 56 #5 at 56 #6 at 48	#4 at 56 #4 at 56 #5 at 56 #6 at 56 #6 at 32		
9 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 4 inches	#4 at 56 #4 at 56 #4 at 56 #4 at 56 #5 at 56 #6 at 56	#4 at 56 #4 at 56 #5 at 56 #5 at 56 #6 at 56 #6 at 40	#4 at 56 #4 at 56 #5 at 56 #6 at 56 #6 at 40 #6 at 24		
10 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 10 feet	#4 at 56 #4 at 56 #4 at 56 #5 at 56 #5 at 56 #6 at 56 #6 at 48	#4 at 56 #4 at 56 #5 at 56 #6 at 56 #6 at 48 #6 at 40 #6 at 32	#4 at 56 #4 at 56 #5 at 56 #6 at 48 #6 at 40 #6 at 24 #6 at 24		

TABLE 404.1.1(3) 10-INCH MASONRY FOUNDATION WALLS WITH REINFORCING WHERE $d \ge 6.75$ INCHES a, c, f

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/mm.

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches in Seismic Design Categories A B and C.

c. Vertical reinforcement shall be Grade 60 minimum. The distance, *d*, from the face of the soil side of the wall to the center of vertical reinforcement shall be not less than 6.75 inches.

d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. Refer to Table 405.1.

e. Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground level. Where an interior concrete slab-on-grade is provided and is in contact with the interior surface of the foundation wall, measurement of the unbalanced backfill height from the exterior finish ground level to the top of the interior concrete slab is permitted.

f. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.1(4)12-INCH MASONRY FOUNDATION WALLSWITH REINFORCING WHERE $d \ge 8.75$ INCHES ^{a, c, f}

		MINIMUM VERTICAL REINFORCEMENT AND SPACING (INC				
WALL	HEIGHT OF	Soil classes and lateral soil load ^d (psf per foot below grade)				
HEIGHT	UNBALANCED BACKFILL ^e	GW, GP, SW and SP soils 30	GM, GC, SM, SM-SC and ML soils 45	SC, ML-CL and inorganic CL soils 60		
6 feet 8 inches	4 feet (or less) 5 feet 6 feet 8 inches	#4 at 72 #4 at 72 #4 at 72	#4 at 72 #4 at 72 #4 at 72	#4 at 72 #4 at 72 #5 at 72		
7 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 4 inches	#4 at 72 #4 at 72 #4 at 72 #4 at 72	#4 at 72 #4 at 72 #4 at 72 #5 at 72	#4 at 72 #4 at 72 #5 at 72 #6 at 72		
8 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet	#4 at 72 #4 at 72 #4 at 72 #4 at 72 #5 at 72	#4 at 72 #4 at 72 #4 at 72 #5 at 72 #6 at 72	#4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 64		
8 feet 8 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 8 inches	#4 at 72 #4 at 72 #4 at 72 #4 at 72 #5 at 72	#4 at 72 #4 at 72 #4 at 72 #5 at 72 #7 at 72	#4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 48		
9 feet 4 inches	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 4 inches	#4 at 72 #4 at 72 #4 at 72 #4 at 72 #5 at 72 #6 at 72	#4 at 72 #4 at 72 #5 at 72 #5 at 72 #6 at 72 #6 at 48	#4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 56 #6 at 40		
10 feet	4 feet (or less) 5 feet 6 feet 7 feet 8 feet 9 feet 10 feet	#4 at 72 #4 at 72 #4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 64	#4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 72 #6 at 56 #6 at 40	#4 at 72 #4 at 72 #5 at 72 #6 at 72 #6 at 48 #6 at 40 #6 at 32		

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/mm.

a. Mortar shall be Type M or S and masonry shall be laid in running bond.

b. Alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per lineal foot of wall shall be permitted provided the spacing of the reinforcement does not exceed 72 inches in Seismic Design Categories A, B and C.

c. Vertical reinforcement shall be Grade 60 minimum. The distance, *d*, from the face of the soil side of the wall to the center of vertical reinforcement shall be not less than 8.75 inches.

d. Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist conditions without hydrostatic pressure. Refer to Table 405.1.

e. Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the interior finish ground levels. Where an interior concrete slab-on-grade is provided and in contact with the interior surface of the foundation wall, measurement of the unbalanced backfill height is permitted to be measured from the exterior finish ground level to the top of the interior concrete slab is permitted.

f. The use of this table shall be prohibited for soil classifications not shown.

404.1.2 Design of masonry foundation walls. Masonry foundation walls shall be designed and constructed in accordance with the provisions of this section or in accordance with the provisions of TMS 402.

404.1.2.1 Masonry foundation walls. Concrete masonry and clay masonry foundation walls shall be constructed as set forth in Table 404.1.1(1), 404.1.1(2), 404.1.1(3) or 404.1.1(4) and shall comply with applicable provisions of Section 606. Rubble stone masonry foundation walls shall be constructed in accordance with Sections 404.1.8 and 606.4.2.

TABLE 404.1.2(1) MINIMUM HORIZONTAL REINFORCEMENT FOR CONCRETE BASEMENT WALLS ^{a, b}

MAXIMUM UNSUPPORTED HEIGHT OF BASEMENT WALL (feet)	LOCATION OF HORIZONTAL REINFORCEMENT
≤ 8	One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near mid-height of the wall story.
> 8	One No. 4 bar within 12 inches of the top of the wall story and one No. 4 bar near third points in the wall story.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa.

a. Horizontal reinforcement requirements are for reinforcing bars with a minimum yield strength of 40,000 psi and concrete with a minimum concrete compressive strength of 2,500 psi.

b. See Section 404.1.3.2 for minimum reinforcement required for foundation walls supporting above-grade concrete walls.

TABLE 404.1.2(2) MINIMUM VERTICAL REINFORCEMENT FOR 6-INCH NOMINAL FLAT CONCRETE BASEMENT WALLS ^{b, c, d, e, g, h, i, j, k}

		MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches) Soil classes ^a and design lateral soil (psf per foot of depth)			
UNSUPPORTED	UNBALANCED				
WALL HEIGHT (feet)	BACKFILL HEIGHT ^f (feet)	GW, GP, SW, SP 30	GM, GC, SM, SM-SC and ML 45	SC, ML-CL and inorganic CL 60	
	4	NR	NR	NR	
	5	NR	6 @ 39	6 @ 48	
8	6	5@39	6 @ 48	6@35	
	7	6@48	6 @ 34	6 @ 25	
	8	6 @ 39	6 @ 25	6@18	
	4	NR	NR	NR	
	5	NR	5 @ 37	6@48	
0	6	5@36	6@44	6@32	
9	7	6@47	6 @ 30	6 @ 22	
	8	6@34	6 @ 22	6@16	
	9	6 @ 27	6 @ 17	DR	
	4	NR	NR	NR	
	5	NR	5 @ 35	6@48	
	6	6 @ 48	6 @ 41	6@30	
10	7	6@43	6 @ 28	6 @ 20	
	8	6@31	6 @ 20	DR	
	9	6 @ 24	6 @ 15	DR	
	10	6@19	DR	DR	

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = $0.1571 \text{ kPa}^2/\text{m}$, 1 pound per square inch = 6.895 kPa.

NR = Not Required.

DR = Design Required.

- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- e. Interpolation is not permitted.
- f. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- g. NR indicates vertical wall reinforcement is not required, except for 6-inch-nominal walls formed with stay-in-place forming systems in which case vertical reinforcement shall be No. 4@48 inches on center.
- h. See Section 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- i. See Table 608.3 for tolerance from nominal thickness permitted for flat walls.
- j. DR means design is required in accordance with the applicable building code, or in the absence of a code, in accordance with ACI 318.
- k. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.2(3) MINIMUM VERTICAL REINFORCEMENT FOR 8-INCH (203 mm) NOMINAL FLAT CONCRETE BASEMENT WALLS ^{b, c, d, e, f, h, i, j}

MAXIMIM	MAXIMUM UNBALANCED	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)			
UNSUPPORTED		Soil classes ^a and design lateral soil (psf per foot of depth)			
WALL HEIGHT	BACKFILL HEIGHT ^g	GW, GP, SW, SP	GM, GC, SM, SM-	SC, ML-CL and	
(leet)	(leet)	30	SC and ML 45	inorganic CL 60	
	4	NR	NR	NR	
	5	NR	NR	NR	
8	6	NR	NR	6 @ 37	
	7	NR	6 @ 36	6 @ 35	
	8	6@41	6 @ 35	6@26	
	4	NR	NR	NR	
	5	NR	NR	NR	
0	6	NR	NR	6@35	
9	7	NR	6 @ 35	6 @ 32	
	8	6 @ 36	6 @ 32	6 @ 23	
	9	6@35	6 @ 25	6@18	
	4	NR	NR	NR	
	5	NR	NR	NR	
	6	NR	NR	6 @ 35	
10	7	NR	6 @ 35	6 @ 29	
	8	6 @ 35	6 @ 29	6 @ 21	
	9	6 @ 34	6 @ 22	6@16	
	10	6 @ 27	6 @ 17	6@13	

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = $0.1571 \text{ kPa}^2/\text{m}$,

1 pound per square inch = 6.895 kPa.

NR = Not Required.

- a. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table 405.1.
- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi, concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. NR indicates vertical reinforcement is not required.
- e. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- f. Interpolation is not permitted.
- g. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- h. See Section 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- i. See Table 608.3 for tolerance from nominal thickness permitted for flat walls.
- j. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.2(4) MINIMUM VERTICAL REINFORCEMENT FOR 10-INCH NOMINAL FLAT CONCRETE BASEMENT WALLS ^{b, c, d, e, f, h, i, j}

MAXIMUM	MAXIMUM	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)			
UNSUPPORTED	UNBALANCED BACKFILL HEIGHT ^g	Soil classes ^a and design lateral soil (psf per foot of depth)			
WALL HEIGHT		GW, GP, SW, SP	GM, GC, SM,	SC, ML-CL and	
(icci)	(icci)	30	SM-SC and ML 45	inorganic CL 60	
	4	NR	NR	NR	
	5	NR	NR	NR	
8	6	NR	NR	NR	
	7	NR	NR	NR	
	8	6@48	6 @ 35	6 @ 28	
	4	NR	NR	NR	
	5	NR	NR	NR	
0	6	NR	NR	NR	
9	7	NR	NR	6 @ 31	
	8	NR	6@31	6 @ 28	
	9	6 @ 37	6 @ 28	6 @ 24	
	4	NR	NR	NR	
	5	NR	NR	NR	
	6	NR	NR	NR	
10	7	NR	NR	6 @ 28	
	8	NR	6 @ 28	6 @ 28	
	9	6 @ 33	6 @ 28	6 @ 21	
	10	6 @ 28	6 @ 23	6 @ 17	

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = 0.1571 kPa²/m, 1 pound per square inch = 6.895 kPa. NR = Not Required.

- a. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table 405.1.
- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. NR indicates vertical reinforcement is not required.
- e. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- f. Interpolation is not permitted.
- g. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- h. See Section 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- i. See Table 608.3 for tolerance from nominal thickness permitted for flat walls.
- j. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.2(5) MINIMUM VERTICAL WALL REINFORCEMENT FOR 6-INCH WAFFLE-GRID BASEMENT WALLS ^{b, c, d, e, g, h, i, j}

MAXIMUM	MAXIMUM	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)				
UNSUPPORTED WALL HEIGHT (feet)	UNBALANCED BACKFILL HEIGHT ^f (feet)	Soil classes ^a and design lateral soil (psf per foot of depth)				
		GW, GP, SW, SP	GM, GC, SM, SM-SC and ML	SC, ML-CL and inorganic CL		
		30	45	60		
	4	4 @ 48	4 @ 46	6 @ 39		
	5	4 @ 45	5@46	6 @ 47		
8	6	5@45	6 @ 40	DR		
	7	6@44	DR	DR		
	8	6 @ 32	DR	DR		
	4	4 @ 48	4 @ 46	4 @ 37		
	5	4 @ 42	5@43	6@44		
9	6	5@41	6 @ 37	DR		
	7	6 @ 39	DR	DR		
	> 8	DR^i	DR	DR		
	4	4 @ 48	4 @ 46	4 @ 35		
	5	4 @ 40	5@40	6 @ 41		
10	6	5 @ 38	6 @ 34	DR		
	7	6 @ 36	DR	DR		
	> 8	DR	DR	DR		

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = 0.1571 kPa²/m,

1 pound per square inch = 6.895 kPa.

DR = Design Required.

- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Maximum spacings shown are the values calculated for the specified bar size. Where the bar used is Grade 60 and the size specified in the table, the actual spacing in the wall shall not exceed a whole-number multiple of 12 inches (12, 24, 36 and 48) that is less than or equal to the tabulated spacing. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- e. Interpolation is not permitted.
- f. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- g. See Section 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- h. See Table 608.3 for thicknesses and dimensions of waffle-grid walls.
- i. DR means design is required in accordance with the applicable building code, or in the absence of a code, in accordance with ACI 318.
- j. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.2(6) MINIMUM VERTICAL REINFORCEMENT FOR 8-INCH WAFFLE-GRID BASEMENT WALLS ^{b, c, d, e, f, h, i, j, k}

MAXIMUM	MAXIMUM UNBALANCED	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)			
UNSUPPORTED		Soil classes ^a and design lateral soil (psf per foot of depth)			
WALL HEIGHT (feet)	BACKFILL HEIGHT ^g (feet)	GW, GP, SW, SP	GM, GC, SM,	SC, ML-CL and	
	(1000)	30	SM-SC and ML 45	inorganic CL 60	
	4	NR	NR	NR	
	5	NR	5@48	5 @ 46	
8	6	5@48	5@43	6 @ 45	
	7	5@46	6@43	6 @ 31	
	8	6@48	6 @ 32	6 @ 23	
	4	NR	NR	NR	
	5	NR	5@47	5@46	
0	6	5@46	5 @ 39	6 @ 41	
9	7	5@42	6 @ 38	6 @ 28	
	8	6@44	6 @ 28	6 @ 20	
	9	6@34	6 @ 21	DR	
	4	NR	NR	NR	
	5	NR	5 @ 46	5@44	
	6	5@46	5 @ 37	6 @ 38	
10	7	5 @ 38	6 @ 35	6 @ 25	
	8	6 @ 39	6 @ 25	DR	
	9	6 @ 30	DR	DR	
	10	6 @ 24	DR	DR	

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = $0.1571 \text{ kPa}^2/\text{m}$,

1 pound per square inch = 6.895 kPa.

NR = Not Required.

DR = Design Required.

- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Maximum spacings shown are the values calculated for the specified bar size. Where the bar used is Grade 60 (420 MPa) and the size specified in the table, the actual spacing in the wall shall not exceed a wholenumber multiple of 12 inches (12, 24, 36 and 48) that is less than or equal to the tabulated spacing. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. NR indicates vertical reinforcement is not required.
- e. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- f. Interpolation shall not be permitted.
- g. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- h. See Section 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- i. See Table 608.3 for thicknesses and dimensions of waffle-grid walls.
- j. DR means design is required in accordance with the applicable building code, or in the absence of a code, in accordance with ACI 318.
- k. The use of this table shall be prohibited for soil classifications not shown.

MAVIMUM	MAXIMUM UNBALANCED	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)			
UNSUPPORTED		Soil classes ^a and design lateral soil (psf per foot of depth)			
WALL HEIGHT (feet)	BACKFILL HEIGHT ^f (feet)	GW, GP, SW, SP	GM, GC, SM, SM-SC and ML	SC, ML-CL and inorganic CL	
		30	45	60	
	4	4 @ 48	4 @ 48	5 @ 43	
	5	4 @ 48	5@48	5 @ 37	
8	6	5@48	6@45	6 @ 32	
	7	6@48	DR	DR	
	8	6@36	DR	DR	
	4	4 @ 48	4 @ 48	4 @ 41	
	5	4 @ 48	5@48	6@48	
9	6	5@45	6 @ 41	DR	
	7	6@43	DR	DR	
	> 8	DR	DR	DR	
	4	4 @ 48	4 @ 48	4 @ 39	
	5	4 @ 44	5@44	6 @ 46	
10	6	5@42	6 @ 38	DR	
	7	6 @ 40	DR	DR	
	> 8	DR	DR	DR	

TABLE 404.1.2(7) MINIMUM VERTICAL REINFORCEMENT FOR 6-INCH (152 mm) SCREEN-GRID BASEMENT WALLS ^{b, c, d, e, g, h, i, j}

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = $0.1571 \text{ kPa}^2/\text{m}$, 1 pound per square inch = 6.895 kPa.

DR = Design Required.

- b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi, concrete with a minimum specified compressive strength of 2,500 psi and vertical reinforcement being located at the centerline of the wall. See Section 404.1.3.3.7.2.
- c. Maximum spacings shown are the values calculated for the specified bar size. Where the bar used is Grade 60 and the size specified in the table, the actual spacing in the wall shall not exceed a whole-number multiple of 12 inches (12, 24, 36 and 48) that is less than or equal to the tabulated spacing. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. Deflection criterion is L/240, where L is the height of the basement wall in inches.
- e. Interpolation is not permitted.
- f. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.
- g. See Sections 404.1.3.2 for minimum reinforcement required for basement walls supporting above-grade concrete walls.
- h. See Table 608.3 for thicknesses and dimensions of screen-grid walls.
- i. DR means design is required in accordance with the applicable building code, or in the absence of a code, in accordance with ACI 318.
- j. The use of this table shall be prohibited for soil classifications not shown.
TABLE 404.1.2(8)MINIMUM VERTICAL REINFORCEMENT FOR6-, 8-, 10- AND 12-INCH NOMINAL FLAT BASEMENT WALLS b, c, d, e, f, h, i, k, n, o

	MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches)														
MAXIMIM	MAXIMUM				Soil cl	asses₄ and d	lesign latera	al soil (psf p	er foot of d	epth)					
WALL HEIGHT	UNBALANCED BACKFILL		GW, GP, 30	SW, SP		GM,	GC, SM, SI 45	M-SC and N	۸L	SC,	8 10 12 NR NR NR NR NR NR				
(feet)	(feet)		Minimum nominal wall thickness (inches)												
		6	8	10	12	6	8	10	12	6	8	10	12		
5	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
5	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
6	5	NR	NR	NR	NR	NR	NR ¹	NR	NR	4 @ 35	NR ¹	NR	NR		
	6	NR	NR	NR	NR	5@48	NR	NR	NR	5@36	NR	NR	NR		
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
7	5	NR	NR	NR	NR	NR	NR	NR	NR	5@47	NR	NR	NR		
,	6	NR	NR	NR	NR	5@42	NR	NR	NR	6@43	5@48	NR ¹	NR		
	7	5@46	NR	NR	NR	6@42	5@46	NR ¹	NR	6@34	6@48	NR	NR		
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
8	5	NR	NR	NR	NR	4@38	NR ¹	NR	NR	5@43	NR	NR	NR		
	6	4 @ 37	NR ¹	NR	NR	5@37	NR	NR	NR	6@37	5@43	NR ¹	NR		
	7	5@40	NR	NR	NR	6@37	5@41	NR ¹	NR	6@34	6@43	NR	NR		
	8	6@43	5@47	NR ¹	NR	6@34	6@43	NR	NR	6 @ 27	6@32	6@44	NR		
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
	5	NR	NR	NR	NR	4 @ 35	NR ¹	NR	NR	5@40	NR	NR	NR		
0	6	4 @ 34	NR ¹	NR	NR	6@48	NR	NR	NR	6@36	6 @ 39	NR ¹	NR		
7	7	5@36	NR	NR	NR	6@34	5@37	NR	NR	6@33	6@38	5@37	NR ¹		
	8	6@38	5@41	NR ¹	NR	6@33	6@38	5@37	NR ¹	6@24	6@29	6@39	4 @ 48 ^m		
	9	6@34	6@46	NR	NR	6@26	6@30	6@41	NR	6@19	6@23	6@30	6@39		
	4	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR		
	5	NR	NR	NR	NR	4@33	NR ¹	NR	NR	5@38	NR	NR	NR		
10	6	5@48	NR ¹	NR	NR	6@45	NR	NR	NR	6@34	5@37	NR	NR		
	7	6@47	NR	NR	NR	6@34	6@48	NR	NR	6@30	6 @ 35	6@48	NR ¹		
	8	6@34	5@38	NR	NR	6@30	6@34	6@47	NR ¹	6 @ 22	6@26	6@35	6 @ 45 ^m		
	9	6@34	6@41	4@48	NR ¹	6@23	6 @ 27	6@35	4 @ 48 ^m	DR	6@22	6 @ 27	6@34		
	10	6@28	6@33	6@45	NR	DR ^j	6@23	6 @ 29	6@38	DR	6@22	6@22	6@28		

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 pound per square foot per foot = $0.1571 \text{ kPa}^2/\text{m}$, 1 pound per square inch = 6.895 kPa.

NR = Not Required. DR = Design Required.

a. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table 405.1.

b. Table values are based on reinforcing bars with a minimum yield strength of 60,000 psi.

- c. Vertical reinforcement with a yield strength of less than 60,000 psi and bars of a different size than specified in the table are permitted in accordance with Section 404.1.3.3.7.6 and Table 404.1.2(9).
- d. NR indicates vertical wall reinforcement is not required, except for 6-inch nominal walls formed with stay-in-place forming systems in which case vertical reinforcement shall be No. 4@48 inches on center.
- e. Allowable deflection criterion is L/240, where L is the unsupported height of the basement wall in inches.

f. Interpolation is not permitted.

g. Where walls will retain 4 feet or more of unbalanced backfill, they shall be laterally supported at the top and bottom before backfilling.

h. Vertical reinforcement shall be located to provide a cover of $1^{1}/_{4}$ -inches measured from the inside face of the wall. The center of the steel shall not vary from the specified location by more than the greater of 10 percent of the wall thickness or $3^{1}/_{8}$ -inch.

i. Concrete cover for reinforcement measured from the inside face of the wall shall be not less than 3/4 -inch. Concrete cover for reinforcement measured from the outside face of the wall shall be not less than $1^{1}/_{2}$ -inches for No. 5 bars and smaller, and not less than 2 -inches for larger bars.

j. DR means design is required in accordance with the applicable building code, or in the absence of a code, in accordance with ACI 318.

k. Concrete shall have a specified compressive strength, f'_c , of not less than 2,500 psi at 28 days, unless a higher strength is required by Footnote l or m.

1. The minimum thickness is permitted to be reduced 2 inches, provided that the minimum specified compressive strength of concrete, f'_c , is 4,000 psi.

m. A plain concrete wall with a minimum nominal thickness of 12 inches is permitted, provided that the minimum specified compressive strength of concrete, f'_c , is 3,500 psi.

n. See Table 608.3 for tolerance from nominal thickness permitted for flat walls.

o. The use of this table shall be prohibited for soil classifications not shown.

TABLE 404.1.2(9) MINIMUM SPACING FOR ALTERNATE BAR SIZE AND ALTERNATE GRADE OF STEEL a, b, c

	BAR SIZE FROM APPLICABLE TABLE IN SECTION 404.1.3.2														
PAD SDACING FDOM		#4 #5 #6													
APPLICABLE TABLE IN					Alter	nate bar	size and	alternate	grade of	steel des	ired				
SECTION 404.1.3.2	Grad	le 60	U	Grade 40		Grad	le 60	Ū	Grade 40		Grad	le 60		Grade 40	
(inclies)	#5	#6	#4	#5	#6	#4	#6	#4	#5	#6	#4	#5	#4	#5	#6
				Maxim	um spaci	ng for alt	ernate ba	ar size an	d alterna	te grade	of steel (i	nches)	I		
8	12	18	5	8	12	5	11	3	5	8	4	6	2	4	5
9	14	20	6	9	13	6	13	4	6	9	4	6	3	4	6
10	16	22	7	10	15	6	14	4	7	9	5	7	3	5	7
11	17	24	7	11	16	7	16	5	7	10	5	8	3	5	7
12	19	26	8	12	18	8	17	5	8	11	5	8	4	6	8
13	20	29	9	13	19	8	18	6	9	12	6	9	4	6	9
14	22	31	9	14	21	9	20	6	9	13	6	10	4	7	9
15	23	33	10	16	22	10	21	6	10	14	7	11	5	7	10
16	25	35	11	17	23	10	23	7	11	15	7	11	5	8	11
17	26	37	11	18	25	11	24	7	11	16	8	12	5	8	11
18	28	40	12	19	26	12	26	8	12	17	8	13	5	8	12
19	29	42	13	20	28	12	27	8	13	18	9	13	6	9	13
20	31	44	13	21	29	13	28	9	13	19	9	14	6	9	13
21	33	46	14	22	31	14	30	9	14	20	10	15	6	10	14
22	34	48	15	23	32	14	31	9	15	21	10	16	7	10	15
23	36	48	15	24	34	15	33	10	15	22	10	16	7	11	15
24	37	48	16	25	35	15	34	10	16	23	11	17	7	11	16
25	39	48	17	26	37	16	35	11	17	24	11	18	8	12	17
26	40	48	17	27	38	17	37	11	17	25	12	18	8	12	17
27	42	48	18	28	40	17	38	12	18	26	12	19	8	13	18
28	43	48	19	29	41	18	40	12	19	26	13	20	8	13	19
29	45	48	19	30	43	19	41	12	19	27	13	20	9	14	19
30	47	48	20	31	44	19	43	13	20	28	14	21	9	14	20
31	48	48	21	32	45	20	44	13	21	29	14	22	9	15	21
32	48	48	21	33	47	21	45	14	21	30	15	23	10	15	21
33	48	48	22	34	48	21	47	14	22	31	15	23	10	16	22
34	48	48	23	35	48	22	48	15	23	32	15	24	10	16	23
35	48	48	23	36	48	23	48	15	23	33	16	25	11	16	23
36	48	48	24	37	48	23	48	15	24	34	16	25	11	17	24
37	48	48	25	38	48	24	48	16	25	35	17	26	11	17	25
38	48	48	25	39	48	25	48	16	25	36	17	27	12	18	25
39	48	48	26	40	48	25	48	17	26	37	18	27	12	18	26
40	48	48	27	41	48	26	48	17	27	38	18	28	12	19	27
41	48	48	27	42	48	26	48	18	27	39	19	29	12	19	27
42	48	48	28	43	48	27	48	18	28	40	19	30	13	20	28
43	48	48	29	44	48	28	48	18	29	41	20	30	13	20	29
44	48	48	29	45	48	28	48	19	29	42	20	31	13	21	29
45	48	48	30	47	48	29	48	19	30	43	20	32	14	21	30
46	48	48	31	48	48	30	48	20	31	44	21	32	14	22	31
47	48	48	31	48	48	30	48	20	31	44	21	33	14	22	31
48	48	48	32	48	48	31	48	21	32	45	22	34	15	23	32

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 6.895 kPa.

This table is for use with tables in Section 404.1.3.2 that specify the minimum bar size and maximum spacing of vertical wall reinforcement for foundation walls and above-grade walls. Reinforcement specified in tables in Section 404.1.3.2 is based on Grade 60 steel reinforcement. a.

b.

Bar spacing shall not exceed 48 inches on center and shall be not less than one-half the nominal wall thickness. For Grade 50 steel bars (ASTM A996, Type R), use spacing for Grade 40 bars or interpolate between Grades 40 and 60. c.

404.1.3 Concrete foundation walls. Concrete foundation walls that support light-frame walls shall be designed and constructed in accordance with the provisions of this section, ACI 318, ACI 332 or PCA 100. Concrete foundation walls that support above-grade concrete walls that are within the applicability limits of Section 608.2 shall be designed and constructed in accordance with the provisions of this section, ACI 318, ACI 332 or PCA 100. Concrete foundation walls that support above-grade concrete walls that are not within the applicability limits of Section 608.2 shall be designed and constructed in accordance with the applicability limits of Section 608.2 shall be designed and constructed in accordance with the applicability limits of Section 608.2 shall be designed and constructed in accordance with the applicability limits of Section 608.2 shall be designed and constructed in accordance with the provisions of ACI 318, ACI 332 or PCA 100.

404.1.3.1 Concrete cross-section. Concrete walls constructed in accordance with this code shall comply with the shapes and minimum concrete cross-sectional dimensions required by Table 608.3. Other types of forming systems resulting in concrete walls not in compliance with this section and Table 608.3 shall be designed in accordance with ACI 318.

404.1.3.2 Reinforcement for foundation walls. Concrete foundation walls shall be laterally supported at the top and bottom. Horizontal reinforcement shall be provided in accordance with Table 404.1.2(1). Vertical reinforcement shall be provided in accordance with Table 404.1.2(2), 404.1.2(3), 404.1.2(4), 404.1.2(5), 404.1.2(6), 404.1.2(7) or 404.1.2(8). Vertical reinforcement for flat basement walls retaining 4 feet (1219 mm) or more of unbalanced backfill is permitted to be determined in accordance with Table 404.1.2(8). For basement walls supporting above-grade concrete walls, vertical reinforcement shall be the greater of that required by Tables 404.1.2(2) through 404.1.2(8) or by Section 608.6 for the above-grade wall.

404.1.3.2.1 Concrete foundation stem walls supporting above-grade concrete walls. Foundation stem walls that support above-grade concrete walls shall be designed and constructed in accordance with this section.

1. Stem walls not laterally supported at top. Concrete stem walls that are not monolithic with slabs-on-ground or are not otherwise laterally supported by slabs-on-ground shall comply with this section. Where unbalanced backfill retained by the stem wall is less than or equal to 18 inches (457 mm), the stem wall and above-grade wall it supports shall be provided with vertical reinforcement in accordance with Section 608.6 and Table 608.6(1), 608.6(2) or 608.6(3) for above-grade walls. Where unbalanced backfill retained by the stem wall is greater than 18 inches (457 mm), the stem wall and above-grade wall it supports wall and above-grade walls.

supports shall be provided with vertical reinforcement in accordance with Section 608.6 and Table 608.6(4).

2. Stem walls laterally supported at top. Concrete stem walls that are monolithic with slabs-on-ground or are otherwise laterally supported by slabs-on-ground shall be vertically reinforced in accordance with Section 608.6 and Table 608.6(1), 608.6(2) or 608.6(3) for above-grade walls. Where the unbalanced backfill retained by the stem wall is greater than 18 inches (457 mm), the connection between the stem wall and the slab-on-ground, and the portion of the slab-on-ground providing lateral support for the wall shall be designed in accordance with PCA 100 or with accepted engineering practice. Where the unbalanced backfill retained by the stem wall is greater than 18 inches (457 mm), the minimum nominal thick- ness of the wall shall be 6 inches (152 mm).

404.1.3.2.2 Concrete foundation stem walls supporting light-frame above-grade walls. Concrete foundation stem walls that support lightframe, above-grade walls shall be designed and constructed in accordance with this section.

- 1. Stem walls not laterally supported at top. Concrete stem walls that are not monolithic with slabs-on-ground or are not otherwise laterally supported by slabs-on-ground and retain 48 inches (1219 mm) or less of unbalanced fill, measured from the top of the wall, shall be constructed in accordance with Section 404.1.3. Foundation stem walls that retain more than 48 inches (1219 mm) of unbalanced fill, measured from the top of the wall, shall be designed in accordance with Sections 404.1.4 and 404.4.
- 2. Stem walls laterally supported at top. Concrete stem walls that are monolithic with slabs-on-ground or are otherwise laterally supported by slabs-on-ground shall be constructed in accordance with Section 404.1.3. Where the unbalanced backfill retained by the stem wall is greater than 48 inches (1219 mm), the connection between the stem wall and the slab-on-ground, and the portion of the slab-on-ground providing lateral support for the wall, shall be designed in accordance with PCA 100 or in accordance with accepted engineering practice.

404.1.3.3 Concrete, materials for concrete, and forms. Materials used in concrete, the concrete itself and forms shall conform to requirements of this section or ACI 318.

404.1.3.3.1 Compressive strength. The minimum specified compressive strength of concrete, f'_c , shall comply with Section 402.2 and shall be not less than 2,500 psi (17.2 MPa) at 28 days in buildings assigned to Seismic Design Category A, B or C.

404.1.3.3.2 Concrete mixing and delivery. Mixing and delivery of concrete shall comply with ASTM C94 or ASTM C685.

404.1.3.3.3 Maximum aggregate size. The nominal maximum size of coarse aggregate shall not exceed one-fifth the narrowest distance between sides of forms, or three-fourths the clear spacing between reinforcing bars or between a bar and the side of the form.

Exception: Where approved, these limitations shall not apply where removable forms are used and workability and methods of consolidation permit concrete to be placed without honeycombs or voids.

404.1.3.3.4 Proportioning and slump of concrete. Proportions of materials for concrete shall be established to provide workability and consistency to permit concrete to be worked readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding. Slump of concrete placed in removable forms shall not exceed 6 inches (152 mm).

Exception: Where approved, the slump is permitted to exceed 6 inches (152 mm) for concrete mixtures that are resistant to segregation, and are in accordance with the form manufacturer's recommendations.

Slump of concrete placed in stay-in-place forms shall exceed 6 inches (152 mm). Slump of concrete shall be determined in accordance with ASTM C143.

404.1.3.3.5 Consolidation of concrete. Concrete shall be consolidated by suitable means during placement and shall be worked around embedded items and reinforcement and into corners of forms. Where stay-in-place forms are used, concrete shall be consolidated by internal vibration.

Exception: Where approved for concrete to be placed in stay-inplace forms, self-consolidating concrete mixtures with slumps equal to or greater than 8 inches (203 mm) that are specifically designed for placement without internal vibration need not be internally vibrated.

404.1.3.3.6 Form materials and form ties. Forms shall be made of wood, steel, aluminum, plastic, a composite of cement and foam insulation, a composite of cement and wood chips, or other approved material suitable for supporting and containing concrete. Forms shall provide sufficient strength to contain concrete during the concrete placement operation.

Form ties shall be steel, solid plastic, foam plastic, a composite of cement and wood chips, a composite of cement and foam plastic, or other suitable material capable of resisting the forces created by fluid pressure of fresh concrete.

404.1.3.3.6.1 Stay-in-place forms. Stay-in-place concrete forms shall comply with this section.

- 1. Surface burning characteristics. The flame-spread index and smoke-developed index of forming material, other than foam plastic, left exposed on the interior shall comply with Section 302. The surface burning characteristics of foam plastic used in insulating concrete forms shall comply with Section 316.3.
- 2. Interior covering. Stay-in-place forms constructed of rigid foam plastic shall be protected on the interior of the building as required by Section 316. Where gypsum board is used to protect the foam plastic, it shall be installed with a mechanical fastening system. Use of adhesives in addition to mechanical fasteners is permitted.
- 3. Exterior wall covering. Stay-in-place forms constructed of rigid foam plastics shall be protected from sunlight and physical damage by the application of an approved exterior wall covering complying with this code. Exterior surfaces of other stay-in-place forming systems shall be protected in accordance with this code.
- 4. Termite protection. In areas where the probability of termite infestation is "very heavy" as indicated by Table 301.2(1) or Figure 301.2(7), foam plastic insulation shall be permitted below grade on foundation walls in accordance with Section 318.4.
- 5. Flat ICF wall system forms shall conform to ASTM E2634.

404.1.3.3.7 Reinforcement.

404.1.3.3.7.1 Steel reinforcement. Steel reinforcement shall comply with the requirements of ASTM A615, A706, or A996. ASTM A996 bars produced from rail steel shall be Type R. In buildings assigned to Seismic Design Category A, B or C, the minimum yield strength of reinforcing steel shall be 40,000 psi (Grade 40) (276 MPa).

404.1.3.3.7.2 Location of reinforcement in wall. The center of vertical reinforcement in basement walls determined from Tables 404.1.2(2) through 404.1.2(7) shall be located at the centerline of the wall. Vertical reinforcement in basement walls determined from Table 404.1.2(8) shall be located to provide a maximum cover of $1^{1}/_{4}$ -inches(32 mm) measured from the inside face of the wall. Regardless of the table used to determine vertical wall reinforcement, the center of the steel shall not vary from the specified location by more than the greater of 10 percent of the wall thickness and 3_{18} -inch (10 mm). Horizontal and vertical reinforcement shall be located in foundation walls to provide the minimum cover required by Section 404.1.3.3.7.4.

404.1.3.3.7.3 Wall openings. Vertical wall reinforcement required by Section 404.1.3.2 that is interrupted by wall openings shall have additional vertical reinforcement of the same size placed within 12 inches (305 mm) of each side of the opening.

404.1.3.3.7.4 Support and cover. Reinforcement shall be secured in the proper location in the forms with tie wire or other bar support system to prevent displacement during the concrete placement operation. Steel reinforcement in concrete cast against the earth shall have a minimum cover of 3 inches (75 mm). Minimum cover for reinforcement in concrete cast in removable forms that will be exposed to the earth or weather shall be $1^{1}/_{2}$ -inches (38 mm) for No. 5 bars and smaller, and 2 inches (50 mm) for No. 6 bars and larger. For concrete cast in removable forms that will not be exposed to the earth or weather, and for concrete cast in stay-in-place forms, minimum cover shall be $3^{1}/_{4}$ -inch (19 mm). The minus tolerance for cover shall not exceed the smaller of one-third the required cover or $3^{1}/_{8}$ -inch (10 mm).

404.1.3.3.7.5 Lap splices. Vertical and horizontal wall reinforcement shall be the longest lengths practical. Where splices are necessary in reinforcement, the length of lap splice shall be in accordance with Table 608.5.4(1) and Figure 608.5.4(1). The

maximum gap between noncontact parallel bars at a lap splice shall not exceed the smaller of one-fifth the required lap length and 6 inches (152 mm) [See Figure 608.5.4(1)].

404.1.3.3.7.6 Alternate grade of reinforcement and spacing. Where tables in Section 404.1.3.2 specify vertical wall reinforcement based on minimum bar size and maximum spacing, which are based on Grade 60 (414 MPa) steel reinforcement, different size bars or bars made from a different grade of steel are permitted provided that an equivalent area of steel per linear foot of wall is provided. Use of Table 404.1.2(9) is permitted to determine the maxi- mum bar spacing for different bar sizes than specified in the tables or bars made from a different grade of steel. Bars shall not be spaced less than one-half the wall thickness, or more than 48 inches (1219 mm) on center.

404.1.3.3.7.7 Standard hooks. Where reinforcement is required by this code to terminate with a standard hook, the hook shall comply with Section 608.5.4.5 and Figure 608.5.4(3).

404.1.3.3.7.8 Construction joint reinforcement. Construction joints in foundation walls shall be made and located to not impair the strength of the wall. Construction joints in plain concrete walls, including walls required to have not less than No. 4 bars at 48 inches (1219 mm) on center by Sections 404.1.3.2 and 404.1.4.2, shall be located at points of lateral support, and not fewer than one No. 4 bar shall extend across the construction joint at a spacing not to exceed 24 inches (610 mm) on center. Construction joint reinforcement shall have not less than 12 inches (305 mm) embedment on both sides of the joint. Construction joints in reinforced concrete walls shall be located in the middle third of the span between lateral supports, or located and constructed as required for joints in plain concrete walls.

Exception: Use of vertical wall reinforcement required by this code is permitted in lieu of construction joint reinforcement provided that the spacing does not exceed 24 inches (610 mm), or the combination of wall reinforcement and No. 4 bars described in this section does not exceed 24 inches (610 mm).

404.1.3.3.8 Exterior wall coverings. Requirements for installation of masonry veneer, stucco and other wall coverings on the exterior of concrete walls and other construction details not covered in this section

shall comply with the requirements of this code.

404.1.3.4 Requirements for Seismic Design Category C. Concrete foundation walls supporting above-grade concrete walls in *dwellings with four or more dwelling units* assigned to Seismic Design Category C shall comply with ACI 318, ACI 332 or PCA 100 (see Section 404.1.3).

404.1.4 Seismic Design Category D₀, D₁ or D₂. deleted

404.1.4.1 Masonry foundation walls. deleted

404.1.4.2 Concrete foundation walls. deleted

404.1.5 Foundation wall thickness based on walls supported. The thickness of masonry or concrete foundation walls shall be not less than that required by Section 404.1.5.1 or 404.1.5.2, respectively.

404.1.5.1 Masonry wall thickness. Masonry foundation walls shall be not less than the thickness of the wall supported, except that masonry foundation walls of not less than 8- inch (203 mm) nominal thickness shall be permitted under brick veneered frame walls and under 10- inch-wide (254 mm) cavity walls where the total height of the wall supported, including gables, is not more than 20 feet (6096 mm), provided that the requirements of Section 404.1.1 are met.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.0175 rad

FIGURE 404.1.5(1) FOUNDATION WALL CLAY MASONRY CURTAIN WALL WITH CONCRETE MASONRY PIERS

404.1.5.2 Concrete wall thickness. The thickness of concrete foundation walls shall be equal to or greater than the thickness of the wall in the story above. Concrete foundation walls with corbels, brackets or other projections built into the wall for support of masonry veneer or other purposes are not within the scope of the tables in this section.

Where a concrete foundation wall is reduced in thickness to provide a shelf for the support of masonry veneer, the reduced thickness shall be equal to or greater than the thickness of the wall in the story above. Vertical reinforcement for the foundation wall shall be based on Table 404.1.2(8) and located in the wall as required by Section 404.1.3.3.7.2 where that table is used. Vertical reinforcement shall be based on the thickness of the thinner portion of the wall.

Exception: Where the height of the reduced thickness portion measured to the underside of the floor assembly or sill plate above is less than or equal to 24 inches (610 mm) and the reduction in thickness does not exceed 4 inches (102 mm), the vertical reinforcement is permitted to be based on the thicker portion of the wall.

404.1.5.3 Pier and curtain wall foundations. Use of pier and curtain wall foundations shall be permitted to support light-frame construction not more than two stories in height, provided that the following requirements are met:

- 1. All load-bearing walls shall be placed on continuous concrete footings placed integrally with the exterior wall footings.
- 2. The minimum actual thickness of a load-bearing masonry wall shall be not less than 4 inches (102 mm) nominal or $3^{3}/_{8}$ -inches (92 mm) actual thickness, and shall be bonded integrally with piers spaced in accordance with Section 606.6.4.
- 3. Piers shall be constructed in accordance with Sections 606.7 and 606.7.1, and shall be bonded into the load-bearing masonry wall in accordance with Section 606.13.1 or 606.13.1.1.
- 4. The maximum height of a 4-inch (102 mm) load-bearing masonry foundation wall supporting wood-frame walls and floors shall be not more than 4 feet (1219 mm).
- 5. Anchorage shall be in accordance with Section 403.1.6, Figure 404.1.5(1), or as specified by engineered design accepted by the building official.
- 6. The unbalanced fill for 4-inch (102 mm) foundation walls shall not exceed 24 inches (610 mm) for solid masonry or 12 inches (305 mm) for hollow masonry.
- 7. *deleted*

404.1.6 Height above finished grade. Concrete and masonry foundation walls shall extend above the finished grade adjacent to the foundation at all points not less than 4 inches (102 mm) where masonry veneer is used and not less than 6 inches (152 mm) elsewhere.

404.1.7 Backfill placement. Backfill shall not be placed against the wall until the wall has sufficient strength and has been anchored to the floor above, or has been sufficiently braced to prevent damage by the backfill.

Exception: Bracing is not required for walls supporting less than 4 feet (1219 mm) of unbalanced backfill.

404.1.8 Rubble stone masonry. Rubble stone masonry foundation walls shall have a minimum thickness of 16 inches (406 mm), shall not support an unbalanced backfill exceeding 8 feet (2438 mm) in height *and* shall not support a soil pressure greater than 30 pounds per square foot per foot (4.71 kPa/m), and shall not be constructed *for dwellings with four or more dwelling units* in Seismic Design Category C, as established in Figure 301.2(2)

404.1.9 Isolated masonry piers. Isolated masonry piers shall be constructed in accordance with this section and the general masonry construction requirements of Section 606. Hollow masonry piers shall have a minimum nominal thickness of 8 inches (203 mm), with a nominal height not exceeding four times the nominal thickness and a nominal length not exceeding three times the nominal thickness. Where hollow masonry units are solidly filled with concrete or grout, piers shall be permitted to have a nominal height not exceeding to the nominal thickness. Footings for isolated masonry piers shall be sized in accordance with Section 403.1.1.

404.1.9.1 Pier cap. Hollow masonry piers shall be capped with 4 inches (102 mm) of solid masonry or concrete, a masonry cap block, or shall have cavities of the top course filled with concrete or grout. Where required, termite protection for the pier cap shall be provided in accordance with Section 318.

404.1.9.2 Masonry piers supporting floor girders. Masonry piers supporting wood girders sized in accordance with Tables 602.7(1) and 602.7(2) shall be permitted in accordance with this section. Piers supporting girders for interior bearing walls shall have a minimum nominal dimension of 12 inches (305 mm) and a maximum height of 10 feet (3048 mm) from top of footing to bottom of sill plate or girder. Piers supporting girders for

exterior bearing walls shall have a minimum nominal dimension of 12 inches (305 mm) and a maximum height of 4 feet (1220 mm) from top of footing to bottom of sill plate or girder. Girders and sill plates shall be anchored to the pier or footing in accordance with Section 403.1.6 or Figure 404.1.5(1). Floor girder bearing shall be in accordance with Section 502.6.

404.1.9.3 Masonry piers supporting braced wall panels. Masonry piers supporting braced wall panels shall be designed in accordance with accepted engineering practice.

404.1.9.4 Seismic design of masonry piers. Masonry piers in *dwellings with four or more dwelling units* located in Seismic Design Category C, shall be designed in accordance with accepted engineering practice.

404.1.9.5 Masonry piers in flood hazard areas. Masonry piers for dwellings in flood hazard areas shall be designed in accordance with Section 322.

404.2 Wood foundation walls. Wood foundation walls shall be constructed in accordance with the provisions of Sections 404.2.1 through 404.2.6 and with the details shown in Figures 403.1(2) and 403.1(3).

404.2.1 Identification. Load-bearing lumber shall be identified by the grade mark of a lumber grading or inspection agency that has been approved by an accreditation body that complies with DOC PS 20. In lieu of a grade mark, a certificate of inspection issued by a lumber grading or inspection agency meeting the requirements of this section shall be accepted. Wood structural panels shall conform to DOC PS 1 or DOC PS 2 and shall be identified by a grade mark or certificate of inspection issued by an approved agency.

404.2.2 Stud size. The studs used in foundation walls shall be 2-inch by 6-inch (51 mm by 152 mm) members. Where spaced 16 inches (406 mm) on center, a wood species with an F_b value of not less than 1,250 pounds per square inch (8619 kPa) as listed in ANSI AWC NDS shall be used. Where spaced 12 inches (305 mm) on center, an F_b of not less than 875 psi (6033 kPa) shall be required.

404.2.3 Height of backfill. For wood foundations that are not designed and installed in accordance with AWC PWF, the height of backfill against a foundation wall shall not exceed 4 feet (1219 mm). Where the height of fill is more than 12 inches (305 mm) above the interior grade of a crawl space or floor of a basement, the thickness of the plywood sheathing shall meet the

requirements of Table 404.2.3.

TABLE 404.2.3 PLYWOOD GRADE AND THICKNESS FOR WOOD FOUNDATION CONSTRUCTION (30 pcf equivalent-fluid weight soil pressure)

HEIGHT STUD			FACE GRAIN A	CROSS	FACE GRAIN PARALLEL TO STUDS			
OF FILL (inches)	SPACING (inches)	Grade ^a	Minimum thickness (inches)	Span rating	Grade ^a	Minimum thickness (inches) ^{b, c}	Span rating	
			15/22		А	15/32	32/16	
24	12	В	15/52	32/16	В	15/32 °	32/16	
24			15/22		А	15/32 °	32/16	
	16	В	15/32	32/16	В	19/32 ° (4, 5 ply)	40/20	
36	12		15/32	32/16	А	15/32	32/16	
		В			В	15/32 ° (4, 5 ply)	32/16	
					В	19/32 (4, 5 ply)	40/20	
	16	D	15/22 6	22/16	А	19/32	40/20	
	10	В	15/32	32/10	В	23/32	48/24	
	12	D	15/22	22/16	А	15/32 °	32/16	
48		Б	15/52	52/10	В	19/32 ° (4, 5 ply)	40/20	
	16	D	10/22	40/20	Α	19/32 °	40/20	
	16	В	19/32	40/20	А	23/32	48/24	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per cubic foot = 0.1572 kN/m3.

a. Plywood shall be of the following minimum grades in accordance with DOC PS 1 or DOC PS 2:

- 1. DOC PS 1 Plywood grades marked:
 - 1.1. Structural I C-D (Exposure 1).
 - 1.2. C-D (Exposure 1).
- 2. DOC PS 2 Plywood grades marked:
 - 2.1. Structural I Sheathing (Exposure 1).
 - 2.2. Sheathing (Exposure 1).
- 3. Where a major portion of the wall is exposed above ground and a better appearance is desired, the following plywood grades marked exterior are suitable:
 - 3.1. Structural I A-C, Structural I B-C or Structural I C-C (Plugged) in accordance with DOC PS 1.
 - 3.2. A-C Group 1, B-C Group 1, C-C (Plugged) Group 1 or MDO Group 1 in accordance with DOC PS 1.
 - 3.3. Single Floor in accordance with DOC PS 1 or DOC PS 2.
- b. Minimum thickness ¹⁵/₃₂ -inch, except crawl space sheathing shall have not less than ³/₈ -inch for face grain across studs 16 inches on center and maximum 2-foot depth of unequal fill.
- c. For this fill height, thickness and grade combination, panels that are continuous over less than three spans (across less than three stud spacings) require blocking 16 inches above the bottom plate. Offset adjacent blocks and fasten through studs with two 16d corrosion-resistant nails at each end.

404.2.4 Backfilling. Wood foundation walls shall not be backfilled until the basement floor and first floor have been constructed or the walls have been braced. For crawl space construction, backfill or bracing shall be installed on the interior of the walls prior to placing backfill on the exterior.

404.2.5 Drainage and dampproofing. Wood foundation basements shall be drained and dampproofed in accordance with Sections 405 and 406, respectively.

404.2.6 Fastening. Wood structural panel foundation wall sheathing shall be attached to framing in accordance with Table 602.3(1) and Section 402.1.1.

404.3 Wood sill plates. Wood sill plates shall be not less than 2-inch by 4-inch (51 mm by 102 mm) nominal lumber. Sill plate anchorage shall be in accordance with Sections 403.1.6 and 602.11.

404.4 Retaining walls. Retaining walls that are not laterally supported at the top and that retain in excess of 48 inches (1219 mm) of unbalanced fill, or retaining walls exceeding 24 inches (610 mm) in height that resist lateral loads in addition to soil, shall be designed in accordance with accepted engineering practice to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Retaining walls shall be designed for a safety factor of 1.5 against lateral sliding and overturning. This section shall not apply to foundation walls supporting buildings.

404.5 Precast concrete foundation walls.

404.5.1 Design. Precast concrete foundation walls shall be designed in accordance with accepted engineering practice. The design and manufacture of precast concrete foundation wall panels shall comply with the materials requirements of Section 402.3 or ACI 318. The panel design drawings shall be in accordance with Section *106.4.5*.

404.5.2 Precast concrete foundation design drawings. Precast concrete foundation wall design drawings shall be submitted to the building official and approved prior to installation. Drawings shall include, at a minimum, the following information:

- 1. Design loading as applicable.
- 2. Footing design and material.
- 3. Concentrated loads and their points of application.
- 4. Soil bearing capacity.
- 5. Maximum allowable total uniform load.
- 6. Seismic design category.
- 7. Basic wind speed.

404.5.3 Identification. Precast concrete foundation wall panels shall be

identified by a certificate of inspection label issued by an approved inspection agency.

SECTION 405 FOUNDATION DRAINAGE

405.1 Concrete or masonry foundations. Drains shall be provided around concrete or masonry foundations that retain earth and enclose habitable or usable spaces located below grade. Drainage tiles, gravel or crushed stone drains, perforated pipe or other approved systems or materials shall be installed at or below the top of the footing or below the bottom of the slab and shall discharge by gravity or mechanical means into an approved drainage system or other location that complies with the plumbing code. Gravel or crushed stone drains shall extend not less than 1 foot (305 mm) beyond the outside edge of the footing and 6 inches (152 mm) above the top of the footing and be covered with an approved filter membrane material. The top of open joints of drain tiles shall be protected with strips of building paper. Except where otherwise recommended by the drain manufacturer, perforated drains shall be surrounded with an approved filter membrane or the filter membrane shall cover the washed gravel or crushed rock covering the drain. Drainage tiles or perforated pipe shall be placed on not less than 2 inches (51 mm) of washed gravel or crushed rock not less than one sieve size larger than the tile joint opening or perforation and covered with not less than 6 inches (152 mm) of the same material.

Exception: A drainage system is not required where the foundation is installed on well-drained ground or sand-gravel mixture soils according to the Unified Soil Classification System, Group I soils, as detailed in Table 405.1.

	CLASSIFIED .	ACCORDING TO THE UNIFIED	SUIL CLASSIFI	CATION 51	SIEM
SOIL GROUP	UNIFIED SOIL CLASSIFICATION SYSTEM SYMBOL	SOIL DESCRIPTION	DRAINAGE CHARACTERISTICS a	FROST-HEAVE POTENTIAL	VOLUME CHANGE POTENTIAL EXPANSION ^b
GW		Well-graded gravels, gravel sand mixtures, little or no fines	Good	Low	Low
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low
Group I	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low
GM		Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low
	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low
Group II	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Medium	High	Low
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium to Low
	СН	Inorganic clays of high plasticity, fat clays	Poor	Medium	High
Group III	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High
	OL	Organic silts and organic silty clays of low plasticity	Poor	Medium	Medium
Group IV	ОН	Organic clays of medium to high plasticity, organic silts	Unsatisfactory	Medium	High
	Pt	Peat and other highly organic soils	Unsatisfactory	Medium	High

TABLE 405.1 PROPERTIES OF SOILS CLASSIFIED ACCORDING TO THE UNIFIED SOIL CLASSIFICATION SYSTEM

For SI: 1 inch = 25.4 mm.

a. The percolation rate for good drainage is over 4 inches per hour, medium drainage is 2 inches to 4 inches per hour, and poor is less than 2 inches per hour.

b. Soils with a low potential expansion typically have a plasticity index (*PI*) of 0 to 15, soils with a medium potential expansion have a *PI* of 10 to 35 and soils with a high potential expansion have a *PI* greater than 20.

405.1.1 Precast concrete foundation. Precast concrete walls that retain earth and enclose habitable or useable space located below-grade that rest on crushed stone footings shall have a perforated drainage pipe installed below the base of the wall on either the interior or exterior side of the wall, not less than 1 foot (305 mm) beyond the edge of the wall. If the exterior drainage pipe is used, an approved filter membrane material shall cover the pipe. The drainage system shall discharge, *by gravity or mechanical means*, into an approved *drainage* system *or other location that complies with the plumbing code*.

405.2 Wood foundations. Wood foundations enclosing habitable or usable spaces

located below grade shall be adequately drained in accordance with Sections 405.2.1 through 405.2.3.

405.2.1 Base. A porous layer of gravel, crushed stone or coarse sand shall be placed to a minimum thickness of 4 inches (102 mm) under the basement floor. Provision shall be made for automatic draining of this layer and the gravel or crushed stone wall footings.

405.2.2 Vapor retarder. A 6-mil-thick (0.15 mm) polyethylene vapor retarder shall be applied over the porous layer with the basement floor constructed over the polyethylene.

405.2.3 Drainage system. In other than Group I soils, a sump shall be provided to drain the porous layer and footings. The sump shall be not less than 24 inches (610 mm) in diameter or 20 inches square (0.0129 m2), shall extend not less than 24 inches (610 mm) below the bottom of the basement floor and shall be capable of positive gravity or mechanical drainage to remove any accumulated water. The drainage system shall discharge, *by gravity or mechanical means*, into an approved *drainage* system *or other location that complies with the plumbing code*.

SECTION 406

FOUNDATION WATERPROOFING AND DAMPPROOFING

406.1 Concrete and masonry foundation dampproofing. Except where required by Section 406.2 to be waterproofed, foundation walls that retain earth and enclose interior spaces and floors below grade shall be dampproofed from the higher of (a) the top of the footing or (b) 6 inches (152 mm) below the top of the basement floor, to the finished grade. Masonry walls shall have not less than 3/8 -inch (9.5 mm) Portland cement parging applied to the exterior of the wall. The parging shall be dampproofed in accordance with one of the following:

- 1. Bituminous coating.
- 2. Three pounds per square yard (1.63 kg/m2) of acrylic modified cement.
- 3. One-eighth-inch (3.2 mm) coat of surface bonding cement complying with ASTM C887.
- 4. Any material permitted for waterproofing in Section 406.2.
- 5. Other approved methods or materials.
 - **Exception:** Parging of unit masonry walls is not required where a material is approved for direct application to the masonry.

Concrete walls shall be dampproofed by applying any one of the listed

dampproofing materials or any one of the waterproofing materials listed in Section 406.2 to the exterior of the wall.

Exception: Existing foundations shall not be required to be dampproofed where a supplemental interior foundation drainage system is installed and connected to a sump pump.

406.2 Concrete and masonry foundation waterproofing. In areas where a high water table or other severe soil-water conditions are known to exist, exterior foundation walls that retain earth and enclose interior spaces and floors below grade shall be waterproofed from the higher of (a) the top of the footing or (b) 6 inches (152 mm) below the top of the basement floor, to the finished grade. Walls shall be water- proofed in accordance with one of the following:

- 1. Two-ply hot-mopped felts.
- 2. Fifty-five-pound (25 kg) roll roofing.
- 3. Six-mil (0.15 mm) polyvinyl chloride.
- 4. Six-mil (0.15 mm) polyethylene.
- 5. Forty-mil (1 mm) polymer-modified asphalt.
- 6. Sixty-mil (1.5 mm) flexible polymer cement.
- 7. One-eighth-inch (3 mm) cement-based, fiber-reinforced, waterproof coating.
- 8. Sixty-mil (1.5 mm) solvent-free liquid-applied synthetic rubber.

All joints in membrane waterproofing shall be lapped and sealed with an adhesive compatible with the membrane.

Exception:

- *I*. Organic-solvent-based products such as hydrocarbons, chlorinated hydrocarbons, ketones and esters shall not be used for ICF walls with expanded polystyrene form material. Use of plastic roofing cements, acrylic coatings, latex coatings, mortars and pargings to seal ICF walls is permitted. Cold-setting asphalt or hot asphalt shall conform to Type C of ASTM D449. Hot asphalt shall be applied at a temperature of less than 200°F (93°C).
- 2. Where existing exterior or interior dampproofing exists, no waterproofing shall be required.
- 3. Where an existing home has a supplemental interior foundation drainage system connected to a sump pump, no waterproofing shall be required.

406.3 Dampproofing for wood foundations. Wood foundations enclosing habitable or usable spaces located below grade shall be dampproofed in accordance with Sections 406.3.1 through 406.3.4.

406.3.1 Panel joint sealed. Plywood panel joints in the foundation walls shall be sealed full length with a caulking compound capable of producing a moisture-proof seal under the conditions of temperature and moisture content at which it will be applied and used.

406.3.2 Below-grade moisture barrier. A 6-mil-thick (0.15 mm) polyethylene film shall be applied over the below-grade portion of exterior foundation walls prior to backfilling. Joints in the polyethylene film shall be lapped 6 inches (152 mm) and sealed with adhesive. The top edge of the polyethylene film shall be bonded to the sheathing to form a seal. Film areas at grade level shall be protected from mechanical damage and exposure by a pressure-preservative treated lumber or plywood strip attached to the wall several inches above finished grade level and extending approximately 9 inches (229 mm) below grade. The joint between the strip and the wall shall be caulked full length prior to fastening the strip to the wall. Where approved, other coverings appropriate to the architectural treatment shall be permitted to be used. The polyethylene film shall extend down to the bottom of the wood footing plate but shall not overlap or extend into the gravel or crushed stone footing.

406.3.3 Porous fill. The space between the excavation and the foundation wall shall be backfilled with the same material used for footings, up to a height of 1 foot (305 mm) above the footing for well-drained sites, or one-half the total backfill height for poorly drained sites. The porous fill shall be covered with strips of 30-pound (13.6 kg) asphalt paper or 6-mil (0.15 mm) polyethylene to permit water seepage while avoiding infiltration of fine soils.

406.3.4 Backfill. The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation.

406.4 Precast concrete foundation system dampproofing. Except where required by Section 406.2 to be waterproofed, precast concrete foundation walls enclosing habitable or useable spaces located below grade shall be dampproofed in accordance with Section 406.1.

406.4.1 Panel joints sealed. Precast concrete foundation panel joints shall be sealed full height with a sealant meeting ASTM C920, Type S or M, Grade NS, Class 25, Use NT, M or A. Joint sealant shall be installed in accordance with the manufacturer's instructions.

SECTION 407 COLUMNS

407.1 Wood column protection. Wood columns shall be protected against decay as set forth in Section 317.

407.2 Steel column protection. All surfaces (inside and outside) of steel columns shall be given a shop coat of rust inhibitive paint, except for corrosion-resistant steel and steel treated with coatings to provide corrosion resistance.

407.3 Structural requirements. The columns shall be restrained to prevent lateral displacement at the bottom end. Wood columns shall be not less in nominal size than 4 inches by 4 inches (102 mm by 102 mm). Steel columns shall be not less than 3-inch-diameter (76 mm) Schedule 40 pipe manufactured in accordance with ASTM A53 Grade B or approved equivalent.

Exception: In Seismic Design Categories A, B and C, columns not more than 48 inches (1219 mm) in height on a pier or footing are exempt from the bottom end lateral displacement requirement within under-floor areas enclosed by a continuous foundation.

SECTION 408 UNDER-FLOOR SPACE

408.1 Ventilation. The under-floor space between the bottom of the floor joists and the earth under any building (except space occupied by a basement) shall have ventilation openings through foundation walls or exterior walls. The minimum net area of ventilation openings shall be not less than 1 square foot (0.0929 m^2) for each 150 square feet (14 m^2) of under-floor space area, unless the ground surface is covered by a Class 1 vapor retarder material. Where a Class 1 vapor retarder material is used, the minimum net area of ventilation openings shall be not less than 1 square foot (0.0929 m^2) for each 1 square foot (0.0929 m^2) for each 1 square foot (0.0929 m^2) for each 1,500 square feet (140 m^2) of under-floor space area. One such ventilating opening shall be within 3 feet (914 mm) of each corner of the building.

408.2 Openings for under-floor ventilation. The minimum net area of ventilation openings shall be not less than 1 square foot (0.0929 m^2) for each 150 square feet (14 m^2) of under-floor area. One ventilation opening shall be within 3 feet (915 mm) of each corner of the building. Ventilation openings shall be covered for their height and width with any of the following materials provided that the least dimension of the covering shall not exceed ¹/₄-inch(6.4 mm):

1. Perforated sheet metal plates not less than 0.070 -inch (1.8 mm) thick

- 2. Expanded sheet metal plates not less than 0.047 -inch (1.2 mm) thick.
- 3. Cast-iron grill or grating
- 4. Extruded load-bearing brick vents
- 5. Hardware cloth of 0.035 -inch (0.89 mm) wire or heavier
- 6. Corrosion resistant wire mesh, with the least dimension being 1/8-inch (3.2 mm) thick.

Exception: The total area of ventilation openings shall be permitted to be reduced to $1/1,500}$ of the under-floor area where the ground surface is covered with an approved Class I vapor retarder material and the required openings are placed to provide cross ventilation of the space. The installation of operable louvers shall not be permitted.

408.3 Unvented crawl space. Ventilation openings in under-floor spaces specified in Sections 408.1 and 408.2 shall not be required where the following items are provided:

- 1. Exposed earth is covered with a continuous Class I vapor retarder. Joints of the vapor retarder shall overlap by 6 inches (152 mm) and shall be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (152 mm) up the stem wall and shall be attached and sealed to the stem wall or insulation.
- 2. One of the following is provided for the under-floor space:
 - 2.1. Continuously operated mechanical exhaust ventilation at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m2) of crawl space floor area, including an air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section 1102.2.11 of this code.
 - 2.2. Conditioned air supply sized to deliver at a rate equal to 1 cubic foot per minute (0.47 L/s) for each 50 square feet (4.7 m2) of under-floor area, including a return air pathway to the common area (such as a duct or transfer grille), and perimeter walls insulated in accordance with Section 1102.2.11 of this code.
 - 2.3. Plenum in existing structures complying with Section 1601.5, if under-floor space is used as a plenum.
 - 2.4. Dehumidification sized to provide 70 pints (33 liters) of moisture removal per day for every 1,000 square feet (93 m^2) of crawl space floor area.

408.4 Access. Access shall be provided to all under-floor spaces. Access openings through the floor shall be not smaller than 18 inches by 24 inches (457 mm by 610

mm). Openings through a perimeter wall shall be not less than 16 inches by 24 inches (407 mm by 610 mm). Where any portion of the of the through-wall access is below grade, an areaway not less than 16 inches by 24 inches (407 mm by 610 mm) shall be provided. The bottom of the areaway shall be below the threshold of the access opening. Through wall access openings shall not be located under a door to the residence. See Section 1305.1.4 for access requirements where mechanical equipment is located under floors.

408.5 Removal of debris. The under-floor grade shall be cleaned of all vegetation and organic material. Wood forms used for placing concrete shall be removed before a building is occupied or used for any purpose. Construction materials shall be removed before a building is occupied or used for any purpose.

408.6 Finished grade. The finished grade of under-floor surface shall be permitted to be located at the bottom of the footings; however, where there is evidence that the ground-water table can rise to within 6 inches (152 mm) of the finished floor at the building perimeter or where there is evidence that the surface water does not readily drain from the building site, the grade in the under-floor space shall be as high as the outside finished grade, unless an approved drainage system is provided.

408.7 Flood resistance. For buildings located in flood hazard areas as established in Table 301.2(1) *unless otherwise approved by the local flood plain administrator:*

- 1. Walls enclosing the under-floor space shall be provided with flood openings in accordance with Section 322.2.2.
- The finished ground level of the under-floor space shall be equal to or higher than the outside finished ground level on at least one side.
 Exception: Under-floor spaces that meet the requirements of FEMA TB 11-1.

SECTION 409 FOUNDATION INSULATION

409.1 Protection of exposed foundation insulation. Foundation walls and the edges of slab-on-grade floors with exterior applied insulation shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of thermal performance. The protective covering shall cover the exposed insulation and extend to a minimum of 6 inches (153 mm) below grade.

Effective:	3/1/2024
Five Year Review (FYR) Dates:	7/1/2024

CERTIFIED ELECTRONICALLY

Certification

01/29/2024

Date

Promulgated Under: Statutory Authority: Rule Amplifies: Prior Effective Dates: 119.03 3781.10(A)(1) 3781.01, 3781.06, 3781.10, 3781.11, 3791.04, 4740.14 05/27/2006, 01/01/2013, 07/01/2014, 01/01/2016, 07/01/2019

4101:8-34-01 *Electrical*.

[Comment: When a reference is made within this rule to a federal statutory provision, an industry consensus standard, or any other technical publication, the specific date and title of the publication as well as the name and address of the promulgating agency are listed in rule 4101:8-44-01 of the Administrative Code. The application of the referenced standards shall be limited and as prescribed in section 102.5 of rule 4101:8-1-01 of the Administrative Code.]

SECTION 3401 ELECTRICAL

3401.1 *Electrical.* The provisions of the National Electrical Code, NFPA 70, shall be incorporated herein and shall govern the installation, testing and operation of the electrical systems of one-, two- and three-family dwellings and their accessory structures except for the following: including the amendments (1) through (5) listed below.

For the purposes of this Chapter, any reference in NFPA 70 to "one- and twofamily dwellings" will include "one-, two- and three-family dwellings." Where the NFPA 70 requirement identifies a one-family dwelling or a two-family dwelling, a three-family dwelling is regulated as a "multi-family dwelling" (i.e. Section 210.52(E)(1)).

<u>1.</u> Modify Section 210.8(A) to read:

(A) **Dwelling units.** All 125-volt, *single phase, 15- and 20-ampere* receptacles installed in locations *specified in 210.8(A)(1) through* (A)(12) are to have ground-fault circuit-interrupter protection for personnel.

1. <u>2. Modify</u> Section 210.8(A)(2) shall be modified to read:

(2) Garages, and also accessory buildings that have a floor located at or below grade level not intended as habitable rooms and limited to storage areas, work areas, and areas of similar use *except for the receptacle located to serve a garage door opener when the device is a single receptacle and located in the ceiling*.

2. Section 210.8(A)(5) shall be modified to read:

Unfinished portions or areas of the basement not intended as habitable rooms. *Exceptions*:

- *I.* A receptacle supplying only a permanently installed fire alarm or burglar alarm system shall not be required to have ground-fault circuit-interrupter protection.
- 2. A single receptacle located to serve a sump pump shall not be required to have ground-fault circuit interrupter protection when there is a duplex receptacle with ground fault circuit interrupter protection within six (6) feet of the sump pump.
- 3. Section 210.8(D) shall be deleted.

3. Modify Section 210.8(F) to read:

(F) Outdoor Outlets. All outdoor outlets for dwellings, other than those covered in 210.8(A), Exception No. 1, garages with floor level at or below grade, accessory buildings and boathouses, where the outlets are supplied by single-phase branch circuits rated 150 volts or less to ground, and 50 amperes or less, are to be provided with ground-fault circuit-interrupter protection for personnel.

If equipment supplied by an outlet covered under the requirements of this section is replaced, the outlet is to be supplied with GFCI protection.

Exception No. 1: GFCI protection is not required on lighting outlets other than those covered in 210.8(C)

Exception No. 2: GFCI protection is not required for listed HVAC equipment.

4. Section 210.12(A) shall be modified to read:

All 120 volt single phase, 15 and 20 ampere branch circuits supplying outlets or devices installed in dwelling unit kitchens, family rooms, dining rooms, living rooms, parlors, libraries, dens, bedrooms, sun rooms, recreational rooms, closets, hallways, laundry rooms, or similar rooms or areas shall be protected by any of the means described in 210.12(A)(1) through (6):

- (1) A listed combination-type arc-fault circuit interrupter, installed to provide protection of the entire branch circuit.
- (2) A listed branch/feeder-type AFCI installed at the origin of the branchcircuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit.

The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.

- (3) A listed supplemental arc protection circuit breaker installed at the origin of the branch circuit in combination with a listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet box on the branch circuit where all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branchcircuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft.) for a 14 AWG conductor or 21.3 m (70 ft.) for a 12 AWG conductor.
 - c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.
- (4) A listed outlet branch-circuit type arc-fault circuit interrupter installed at the first outlet on the branch circuit in combination with a listed branch-circuit overcurrent protective device where all of the following conditions are met:
 - a. The branch-circuit wiring shall be continuous from the branchcircuit overcurrent device to the outlet branch-circuit arc-fault circuit interrupter.
 - b. The maximum length of the branch-circuit wiring from the branch-circuit overcurrent device to the first outlet shall not exceed 15.2 m (50 ft.) for a 14 AWG conductor or 21.3 m (70 ft.) for a 12 AWG conductor.
 - c. The first outlet box in the branch circuit shall be marked to indicate that it is the first outlet of the circuit.
 - d. The combination of the branch-circuit overcurrent device and outlet branch-circuit AFCI shall be identified as meeting the requirements for a system combination-type AFCI and shall be listed as such.
- (5) If RMC, IMC, EMT, Type MC, or steel-armored Type AC cables meeting the requirements of 250.118, metal wireways, metal auxiliary gutters, and metal outlet and junction boxes are installed for the portion of the branch circuit between the branch-circuit overcurrent device and the first outlet, it shall be permitted to install a listed outlet branchcircuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.
- (6) Where a listed metal or nonmetallic conduit or tubing or Type MC cable is encased in not less than 50 mm (2 in.) of concrete for the portion of the branch circuit between the branch-circuit overcurrent device and the

first outlet, it shall be permitted to install a listed outlet branch-circuit type AFCI at the first outlet to provide protection for the remaining portion of the branch circuit.

- Exception No 1: Where an individual branch circuit to a fire alarm system installed in accordance with 760.41(B) or 760.121(B) is installed in RMC, IMC, EMT, or steel-sheathed cable, Type AC or Type MC, meeting the requirements of 250.118, with metal outlet and junction boxes, AFCI protection shall be permitted to be omitted.
- *Exception No. 2: Branch circuits supplying receptacle outlets installed to serve only the kitchen countertop surfaces shall be permitted to be installed without arc fault circuit interrupter protection.*
- 5. Section 210.64 shall be modified to read:

At least one 125-volt, single-phase, 15- or 20-ampere-rated receptacle outlet shall be installed in an accessible location within 7.5m (25 ft.) of the indoor electrical service equipment. The required receptacle outlet shall be located within the same room or area as the service equipment.

Exception No. 1: The receptacle outlet shall not be required to be installed in one-, two-, or three-family dwellings.

- Exception No. 2: Where the service voltage is greater than 120 volts to ground, a receptacle outlet shall not be required for services dedicated to equipment covered in Articles 675 and 682.
- 4. Modify Section 215.18(A) to read:

(A) Surge-Protection Device. Where provided as part of feeder supplied distribution equipment, surge-protection devices (SPD) are to be installed in accordance with this section.

5. Modify Section 230.67(A) to read:

(A) Surge-Protection Device. Where provided as part of the service entrance equipment, surge-protection devices (SPD) are to be installed in accordance with this section.

SECTION 3402 EMERGENCY AND STANDBY POWER SYSTEMS

3402.1 *Installation. Emergency and standby power systems shall be installed in*

accordance with this code and NFPA 70. The performance, classification, transfer, testing, and maintenance of emergency and standby power systems shall also comply with either NFPA 110 (liquid- and gas- fueled systems) or NFPA 111 (battery and inertia systems), as applicable.

3402.1.1 Stationary generators. Stationary emergency and standby power generator assemblies shall be listed in accordance with UL 2200.

3402.1.1.1 Engine-driven generators. The installation of liquid- and gas- fueled stationary internal combustion engines and gas turbines used to drive generator assemblies shall meet the requirements of NFPA 37.

3402.1.1.11 Fuel tanks connected to generator assemblies. Fuel tanks piped to and supplying fuel for engine-driven generator assemblies may be engine-mounted, located inside of a building, outside of a building, or on a roof in accordance with NFPA 37 or NFPA 30.

3402.1.1.1.1 Engine-mounted tanks. Engine-mounted tanks located outdoors may be located in accordance with Section 4.1.4 of NFPA 37 and shall be vented in accordance with NFPA 30. Engine-mounted tanks shall be provided with adequate clearance to enable filling, maintenance, and testing, shall be safeguarded against public access, and shall be protected from impact.

3402.1.1.1.1.2 Other fuel tanks. Fuel tanks, other than engine-mounted tanks, piped to and supplying the generator engine shall be located, installed, and vented in accordance with the applicable sections of NFPA 37 or located, installed, and vented in accordance with NFPA 30.

3402.1.1.1.2 Gaseous fuel supply. Where an internal combustion engine supplied with gaseous fuel powers emergency or standby generators, the fuel gas storage and piping system shall comply with NFPA 37 and Chapter 24.

Effective:	3/1/2024
Five Year Review (FYR) Dates:	7/1/2024

CERTIFIED ELECTRONICALLY

Certification

01/29/2024

Date

Promulgated Under: Statutory Authority: Rule Amplifies: Prior Effective Dates: 119.03 3781.10(A)(1) 3781.01, 3781.06, 3781.10, 3781.11, 3791.04, 4740.14 01/01/2013, 01/01/2016, 07/01/2019

4101:8-44-01 Referenced standards.

4401.1 General. This chapter lists the standards that are referenced in various sections of this code. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title. The application of the referenced standards shall be as specified in Section 102.5.

4401.2 Referenced codes. When indicated in this code, the following codes refer to provisions in the listed chapters of the administrative code:

Referenced Code	Ohio Administrative Code Chapters
Ohio Building Code Fire Code Mechanical Code Plumbing Code	4101:1-1 to 4101:1-35 1301:7-1 to 1301:7-7 4101:2-1 to 4101:2-15 4101:3-1 to 4101:3-15 , codified and published as the 2017 Ohio Plumbing Code, effective 11-1-2017, and as modified in Section 2501.1.1.

4401.3 Referenced standard list.

AAMA America 1827 W	n Architectural Manufacturers Association alden Office Square, Suite 550
Schaum	burg, IL 60173
Standard Referenced	Title
AAMA/WDMA/CSA 101/	North American Fenestration Standards/
I.S.2/ A440—17:	Specifications for Windows, Doors and Skylights
450—10:	Voluntary Performance Rating Method for
	Mulled Fenestration Assemblies
506—16:	Voluntary Specifications for Hurricane Impact
	and Cycle Testing of Fenestration Products
711— 16 13:	Voluntary Specification for Self-adhering
_	Flashing Used for Installation of Exterior Wall
	Fenestration Products
712—14:	Voluntary Specification for Mechanically
	Attached Flexible Flashing

AAMA	American Architectural Manufacturers Association 1827 Walden Office Square, Suite 550 Schaumburg, IL 60173				
Standard Referen	iced	Title			
714—15:		Voluntary Specification for Liquid Applied Flashing Used to Create a Water-resistive Seal around Exterior Wall Openings in Buildings			
AAMA/NPEA/NS 2100—12:	A	Specifications for Sunrooms			
ACCA	Air Cond 2800 Shi Arlington	litioning Contractors of America rlington Road, Suite 300 n. VA 22206			
Standard referen	ced [Fitle			
Manual D—2016: Manual J—2016: Manual S—2014:]]]	Residential Duct Systems Residential Load Calculation—Eighth Edition Residential Equipment Selection			
ACI American 38800 Co Farmingt		n Concrete Institute ountry Club Drive on Hills, MI 48331			
Standard referen	cea				
318—14: 332—14:]] (Building Code Requirements for Structural Concrete Residential Code Requirements for Structural Concrete			
AISI	American 25 Massa Washing	n Iron and Steel Institute achusetts Avenue, NW Suite 800 ton, DC 20001			
Standard referen	ced [Fitle			
AISI S100—16:	ן כ י	North American Specification for the Design of Cold-formed Steel Structural Members, 2016 North American Standard for Cold-formed Steel			
AISI S220—15. AISI S230—15:	1 1 2 1 1	Framing—Nonstructural Members, 2015 Standard for Cold-formed Steel Framing— Prescriptive Method for One- and Two-family Dwellings, 2015			

AISI	American Iron and Steel Institute 25 Massachusetts Avenue, NW Suite 800 Washington, DC 20001					
Standard reference	ced	Title				
AISI S240—15:		North American Standard for Cold-Formed Steel Structural Framing				
AMCA Air Mo 30 Wes		ovement and Control Association International st University Drive on Heights, IL 60004				
Standard reference	ced	Title				
ANSI/AMCA 210- ANSI/ASHRAE 5	1—07:	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating				
ANCE	Associa Av. Lá: Col. Nu C.P. 07	ation of the Electric Sector zaro Cardenas No. 869 ueva Industrial Vallejo 1700 México D.F.				
Standard reference	ed :	Title				
NMX J 521/2 40- ANCE 2014/ CAN/CSA-22.2 No. 60335-2-40 UL 60335-2-40:	12/	Safety of Household and Similar Electric Appliances, Part 2-40: Particular Requirements for Heat Pumps, Air-Conditioners and Dehumidifiers				
	<u> </u>					
ANSI	Americ 25 Wes New Y	st 43rd Street, 4th Floor ork, NY 10036				
Standard reference	ced	Title				
A108.1A—17: Installation of Ceramic Tile in the Wet-set Method with Portland Cement Mortar						
A108.1B—17: [JR: most current A108 edition is 2017] A108.4 17: Installation of Ceramic Tile, Quarry Tile on a C Portland Cement Mortar Setting Bed with Dry-s or Latex Portland Mortar						
A108.4—1/:		Adhesives or Water-Cleanable Tile-setting Epoxy Adhesive				

ANSI	American National Standards Institute
	25 West 43rd Street, 4th Floor
Standard referen	red Title
Standard Telefen	
A108.5—17:	Installation of Ceramic Tile with Dry-set Portland
A 108 6 17.	Installation of Ceramic Tile with Chemical
A100.0—17.	resistant. Water-cleanable Tile-setting and -grouting
	Epoxy
A108.11—17:	Interior Installation of Cementitious Backer Units
ANSI 117—2015:	Standard Specifications for Structural Glued
	Laminated Timber of Softwood Species
A118.1—17:	American National Standard Specifications for Dry-
A 1 1 0 0 1 0	set Portland Cement Mortar
A118.3—13:	American National Standard Specifications for
	Chemical-resistant, Water-cleanable lile-setting
	setting Epoxy, and water-cleanable The-
A118 4—16·	American National Standard Specifications for
1110.4 10.	Modified Dry-Set Cement Mortar
A118.10—17:	Specification for Load-bearing, Bonded.
	Waterproof Membranes for Thin-set Ceramic Tile
	and Dimension Stone Installation
A136.1—17:	American National Standard Specifications for
	Organic Adhesives for Installation of Ceramic Tile
A137.1—17:	American National Standard Specifications for
	Ceramic Tile
LC1/CSA 6.26—1	<u>318</u> : Fuel Gas Piping Systems Using Corrugated
I C A C C A C 22 1	Stainless Steel Tubing (CSST)
LC4/CSA 0.32—1	2: Press-connect Metallic Fluings for Use in Fuel Gas
7 21 1—2010 [.]	Household Cooking Gas Appliances
Z21.5 1/ CSA 7.1–	-14 [·] Gas Clothes Dryers—
	Volume I—Type I Clothes Dryers
Z21.8—94 (R2002): Installation of Domestic Gas Conversion Burners
Z21.10.1/ CSA 4.1	—12: Gas Water Heaters—Volume I—Storage Water
	Heaters with Input Ratings of 75,000 Btu per hour
701 10 2/ 00 1 4 2	or Less
Z21.10.3/ CSA 4.3	—11: Gas Water Heaters—Volume III—Storage Water
	Heaters with input Katings above /5,000 Btu per
	nour, Circulating and Instantaneous

ANST Amer	can National Standards Institute				
25 W	est 43rd Street, 4th Floor				
New	York, NY 10036				
Standard referenced	Title				
Z21.11.2—11:	Gas-fired Room Heaters—Volume II—Unvented				
Z21.13/ CSA 4.9—11:	Gas-fired Low-pressure Steam and Hot Water Boilers				
Z21.15/ CSA 9.1—09:	Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves				
Z21.22—99 (R2015):	Relief Valves for Hot Water Supply Systems—with Addenda Z21.22a—2000 (R2003) and 21.22b— 2001 (R2003)				
Z21.24/ CSA 6.10—06:	Connectors for Gas Appliances				
Z21.40.1/	Gas-fired, Heat-activated Air-conditioning and Heat				
CSA 2.91—96 (R2011):	Pump Appliances				
Z21.40.2/	Air-conditioning and Heat Pump Appliances				
CSA 2.92—96 (R2011):	(Thermal Combustion)				
Z21.42—2014:	Gas-fired Illuminating Appliances				
Z21.47/ CSA 2.3—12:	Gas-fired Central Furnaces				
Z21.50/ CSA 2.22—16:	Vented Gas Fireplaces				
Z21.54—2009:	Gas Hose Connectors for Portable Outdoor Gas-				
	fired Appliances				
Z21.56/ CSA 4.7—17:	Gas-fired Pool Heaters				
Z21.58—18/	Outdoor Cooking Gas Appliances				
CSA 1.6—18:					
Z21.60/ CSA 2.26—12:	Decorative Gas Appliances for Installation in Solid Fuel-burning Fireplaces				
Z21.69/ CSA 6.16—09:	Connectors for Movable Gas Appliances				
Z21.75/ CSA 6.27—07:	Connectors for Outdoor Gas Appliances and				
	Manufactured Homes				
Z21.80/ CSA 6.22—11:	Line Pressure Regulators				
ANSI/ CSA FC 1-12:	Stationary Fuel Cell Power Systems				
Z21.84—12:	Manually Listed, Natural Gas Decorative Gas				
	Appliances for Installation in Solid Fuel-burning				
	Fireplaces				
Z21.86/ CSA 2.32—08:	Gas-fired Vented Space Heating Appliances				
Z21.88/ CSA 2.33—16:	Vented Gas Fireplace Heaters				
Z21.91—07:	Ventless Firebox Enclosures for Gas-fired				
	Unvented Decorative Room Heaters				

ANSI A	American National Standards Institute	
2	5 West 43rd Street, 4th Floor	
Ν	New York, NY 10036	
Standard reference	d Title	
Z21.93/ CSA 6.30—	13: Excess Flow Valves for Natural and LP Gas with	
	Pressures up to 5 psig	
Z21.97—12:	Outdoor Decorative Appliances	
Z83.6—90 (R1998):	Gas-fired Infrared Heaters	
Z83.8/ CSA 2.6-09	: Gas-fired Unit Heaters, Gas Packaged Heaters, Gas	
	Utility Heaters and Gas-fired Duct Furnaces	
Z83.19—01 (R2009)): Gas-fuel High-intensity Infrared Heaters	
Z83.20—08:	Gas-fired Low-intensity Infared Heaters Outdoor	
	Decorative Appliances	
Z97.1—2014:	Safety Glazing Materials Used in Buildings—	
	Safety Performance Specifications and Methods of	
	Test	
APA A	APA—The Engineered Wood Association	
7	011 South 19th	
Т	Cacoma, WA 98466	
Standard reference	d Title	
ANSI/A190.1—2017	7: Structural Glued-laminated Timber	
ANSI/	Standard for Performance-rated Engineered Wood	
APA PRP 210-201	4: Siding	
ANSI/	Standard for Performance-rated Cross Laminated	
APA PRG 320-201	7: Timber	
ANSI/	Standard for Performance-rated Engineered Wood	
APA PRR 410-201	6: Rim Boards	
ANSI/	Standard for Performance-Rated Structural	
APA PRS 610.1-20	013: Insulated Panels in Wall Applications	
APA E30—15:	Engineered Wood Construction Guide	
ASCE/SEI	American Society of Civil Engineers	
	Structural Engineering Institute	
	1801 Alexander Bell Drive	
	Reston, VA 20191-4400	
Standard reference	d Title	
7—16:	Minimum Design Loads and Associated Criteria for	
	Buildings and Other Structures	
ASCE/SEI	Ame	rican Society of Civil Engineers
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	Struc	tural Engineering Institute
	1801 Bost	Alexander Bell Drive
Standard referen	ced	Title
24 14		
24—14:		Flood-resistant Design and Construction
$52 - \frac{1}{101}$		Shallow Foundations
		Shulow Foundations
ASHRAE	ASHR	AE
	1791 T	Sullie Circle NE
	Atlanta	a, GA 30329
Standard referen	ced	Title
ASHRAE-2001:		2001 ASHRAE Handbook of Fundamentals
		for use in reference to Table 1105.5.2 (1) only
ASHRAE—2017:		ASHRAE Handbook of Fundamentals
ASHRAE 193-2	010	Method of Test for Determining Air Tightness of
(RA 2014):		HVAC Equipment
34 <u>2016</u> 2022:		Designation and Safety Classification of
		Refrigerants
ASME	Americ	can Society of Mechanical Engineers
	I WO Pa	ark Avenue Tork NV 10016 5000
Standard referen		Title
ASME A 17 1 - 20)16/	Safety Code for Floyators and Escalators
$CSA B44 - 16^{\circ}$	/10/	Safety Code for Elevators and Escalators
A18.1—2014:		Safety Standard for Platforms and Stairway Chair
		Lifts
B1.20.1—2013:		Pipe Threads, General-purpose (Inch)
B16.33—2012:		Manually Operated Metallic Gas Valves for Use in
		Gas Piping Systems up to 125 psig (Sizes $1/2$
D16 11 2012		through 2) Manually Operated Matallia Cas Values for Use in
D10.44—2012:		Above-ground Pining Systems up to 5 psi
B36.10M—2004(R2015).	Welded and Seamless Wrought-steel Pipe
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ASME	America	n Society of Mechanical Engineers
	Two Par	k Avenue
	New Yo	rk, NY 10016-5990
Standard reference	ced	Title
BPVC—2015:		ASME Boiler and Pressure Vessel Code (Sections I. II. IV. V. VI and VIII)
CSD-1—2016:		Controls and Safety Devices for Automatically Fired Boilers
ASTM	ASTM 100 Ba West C	International rr Harbor Drive, P.O. Box C700 onshohocken, PA 19428
Standard reference	ced	Title
A36/A36M—14: A53/A53M—12:		Specification for Carbon Structural Steel Specification for Pipe, Steel, Black and Hot-
A106/A106M—14	:	Specification for Seamless Carbon Steel Pipe for High-temperature Service
A123/A123M—15	:	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153/A153M—09	:	Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
A167—99(2009):		Specification for Stainless and Heat-resisting Chromium-nickel Steel Plate, Sheet and Strip
A240/A240M—15	A:	Standard Specification for Chromium and Chromium-nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications
A254—12:		Specification for Copper Brazed Steel Tubing
A268—2010:		Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A269—2015:		Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A307—14:		Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A463/A463M—15	:	Standard Specification for Steel Sheet, Aluminum-coated by the Hot-dip Process

ASTM ASTM In	ternational
100 Barr 1	Harbor Drive, P.O. Box C700
West Con	shohocken, PA 19428
Standard referenced	Title
A539—99:	Specification for Electric-resistance-welded Coiled Steel Tubing for Gas and Fuel Oil Lines
A563—15:	Standard Specification for Carbon and Alloy Steel Nuts
A615/A615M—2015aE1:	Specification for Deformed and Plain Carbon- steel Bars for Concrete Reinforcement
A641/A641M—09a(2014):	Specification for Zinc-coated (Galvanized) Carbon Steel Wire
A653/A653M—15:	Specification for Steel Sheet, Zinc-coated (Galvanized) or Zinc-iron Alloy-coated (Galvannealed) by the Hot-dip Process
A706/A706M—15:	Specification for Low-alloy Steel Deformed and Plain Bars for Concrete Reinforcement
A755/A755M—2015:	Specification for Steel Sheet, Metallic Coated by the Hot-dip Process and Prepainted by the Coil-coating Process for Exterior Exposed Building Products
A792/A792M—10(2015):	Specification for Steel Sheet, 55% Aluminum- zinc Alloy-coated by the Hot-dip Process
A875/A875M—13:	Specification for Steel Sheet, Zinc-5%, Aluminum Alloy-coated by the Hot-dip Process
A924/A924M—14:	Standard Specification for General Requirements for Steel Sheet, Metallic-coated by the Hot-dip Process
A996/A996M—15:	Specifications for Rail-steel and Axle-steel Deformed Bars for Concrete Reinforcement
A1003/A1003M—15:	Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-coated for Cold- formed Framing Members
B42—2015A:	Specification for Seamless Copper Pipe, Standard Sizes
B43—15:	Specification for Seamless Red Brass Pipe, Standard Sizes
B75/B75M—11:	Specification for Seamless Copper Tube
B88—14:	Specification for Seamless Copper Water Tube
B101—12:	Specification for Lead-coated Copper Sheet and Strip for Building Construction

ASTM	ASTM Int 100 Barr I West Con	ternational Harbor Drive, P.O. Box C700 shohocken, PA 19428
Standard referen	ced	Title
B135—10:		Specification for Seamless Brass Tube
B209—14:		Specification for Aluminum and Aluminum- alloy Sheet and Plate
B251—10:		Specification for General Requirements for Wrought Seamless Copper and Copper-alloy Tube
B302—12:		Specification for Threadless Copper Pipe, Standard Sizes
B306—13:		Specification for Copper Drainage Tube (DWV)
B370—12:		Specification for Copper Sheet and Strip for Building Construction
B695—04(2009):		Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
B813—10:		Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
B828—02(2010):		Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
C5—10:		Specification for Quicklime for Structural Purposes
C22/C22M-2015	5:	Specification for Gypsum
C27—98(2013):		Specification for Standard Classification of Fireclay and High-alumina Refractory Brick
C28/C28M-10(2	015):	Specification for Gypsum Plasters
C33/C33M—13:		Specification for Concrete Aggregates
C34—13:		Specification for Structural Clay Load-bearing Wall Tile
C35/C35M—(201	4):	Specification for Inorganic Aggregates for Use in Gypsum Plaster
C55—2014A:		Specification for Concrete Building Brick
C56—13:		Standard Specification for Structural Clay Nonloadbearing Tile
C59/C59M-00(2	015):	Specification for Gypsum Casting Plaster and Molding Plaster
C61/C61M-00(2	.015):	Specification for Gypsum Keene's Cement

ASTM	ASTM International 100 Barr Harbor Drive, P.O. Box C700
	West Conshohocken, PA 19428
Standard reference	d Title
C62—13A:	Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
C73—14:	Specification for Calcium Silicate Face Brick (Sand Lime Brick)
C90—14:	Specification for Load-bearing Concrete Masonry Units
C91/C91M—12:	Specification for Masonry Cement
C94/C94M—15A:	Standard Specification for Ready-mixed
	Concrete
C126—15:	Standard Specification for Ceramic Glazed
	Structural Clay Facing Tile, Facing Brick, and
	Solid Masonry Units
C129—14A:	Specification for Nonload-bearing Concrete
	Masonry Units
C143/C143M—15:	Test Method for Slump of Hydraulic Cement
	Concrete
C145—85:	Specification for Solid Load-bearing Concrete
	Masonry Units
C150/C150M—15:	Specification for Portland Cement
2199—84(2011):	Test Method for Pier Test for Refractory Mortar
C203—05a(2012):	Standard Test Methods for Breaking Load and Flexural Properties of Block-type Thermal Insulation
$C207_06(2011)$	Specification for Hydrated Lime for Masonry
00(2011).	Purposes
C208—12:	Specification for Cellulosic Fiber Insulating
	Board
C212—14:	Standard Specification for Structural Clay
	Facing Tile
C216—15:	Specification for Facing Brick (Solid Masonry
	Units Made from Clay or Shale)
C270—14A:	Specification for Mortar for Unit Masonry
C315—07(2011):	Specification for Clay Flue Liners and Chimney Pots
C406/C406M—201	5: Specifications for Roofing Slate
C411—11:	Test Method for Hot-surface Performance of
	High-temperature Thermal Insulation

ASTM ASTI 100 E West	M International Barr Harbor Drive, P.O. Box C700 Conshohocken, PA 19428
Standard referenced	Title
C475/C475M—15:	Specification for Joint Compound and Joint Tape for Finishing Gypsum Wallboard
C476—10:	Specification for Grout for Masonry
C503/C503M—2010:	Standard Specification for Marble Dimension Stone
C514—04(2014):	Specification for Nails for the Application of Gypsum Wallboard
C552—15:	Standard Specification for Cellular Glass Thermal Insulation
C557—03(2009)e01:	Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing
C568/C568M—2010:	Standard Specification for Limestone Dimension Stone
C578—15:	Specification for Rigid, Cellular Polystyrene Thermal Insulation
C587—04(2014):	Specification for Gypsum Veneer Plaster
C595/C595M—14E1:	Specification for Blended Hydraulic Cements
C615/C615M—11:	Standard Specification for Granite Dimension Stone
C616/C616M—10:	Standard Specification for Quartz-based Dimension Stone
C629/C629M—10:	Standard Specification for Slate Dimension Stone
C631—09(2014):	Specification for Bonding Compounds for Interior Gypsum Plastering
C645—14:	Specification for Nonstructural Steel Framing Members
C652—15:	Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
C685/C685M—14:	Specification for Concrete Made by Volumetric Batching and Continuous Mixing
C726—12:	Standard Specification for Mineral Wool Roof Insulation Board
C728—15:	Standard Specification for Perlite Thermal Insulation Board
C744—14:	Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units

	ASTM In	ternational
ASIM	100 Barr 1	Harbor Drive, P.O. Box C700
	West Con	shohocken. PA 19428
Standard referenc	ed	Title
C836/C836M—15:		Specification for High Solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
C841—03(2013):		Standard Specification for Installation of Interior Lathing and Furring
C842—05(2015):		Standard Specification for Application of Interior Gypsum Plaster
C843—99(2012):		Specification for Application of Gypsum Veneer Plaster
C844—2015:		Specification for Application of Gypsum Base to Receive Gypsum Veneer Plaster
C847—14A:		Specification for Metal Lath
C887—13:		Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar
C897—15:		Specification for Aggregate for Job-mixed Portland Cement-based Plasters
C920—14A:		Standard Specification for Elastomeric Joint Sealants
C926—15B:		Specification for Application of Portland Cement-based Plaster
C933—14:		Specification for Welded Wire Lath
C946—10:		Standard Practice for Construction of Dry- Stacked, Surface-Bonded Walls
C954—15:		Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in (0.84 mm) or to 0.112 in. (2.84 mm) in Thickness
C957/C957M—15:		Specification for High-solids Content, Cold Liquid-applied Elastomeric Waterproofing Membrane for Use with Integral Wearing Surface
C1002—14:		Specification for Steel Self-piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

$\begin{array}{c} \mathbf{ASTM} \\ 1 \end{array}$	ASTM International 00 Barr Harbor Drive, P.O. Box C700
V	Vest Conshohocken, PA 19428
Standard referenced	Title
C1029—15:	Specification for Spray-applied Rigid Cellular Polyurethane Thermal Insulation
C1032—14:	Specification for Woven Wire Plaster Base
C1047—14a:	Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
C1063—15A:	Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-based Plaster
C1088—14:	Standard Specification for Thin Veneer Brick Units Made from Clay or Shale
C1107/C1107M—144	A: Standard Specification for Packaged Dry, Hydraulic-cement Grout (Nonshrink)
C1116/C116M—10(2	2015): Standard Specification for Fiber-reinforced Concrete and Shotcrete
C1157—11/C1157M-	—11: Standard Performance Specification for Hydraulic Cement
C1167—11:	Specification for Clay Roof Tiles
C1177/C1177M—13:	Specification for Glass Mat Gypsum Substrate for Use as Sheathing
C1178/C1178M—13:	Specification for Glass Mat Water-resistant Gypsum Backing Panel
C1186—08(2012):	Specification for Flat Fiber Cement Sheets
C1261—13:	Specification for Firebox Brick for Residential Fireplaces
C1278/C1278M—07a	a(2011): Specification for Fiber-reinforced Gypsum Panels
C1283—11:	Practice for Installing Clay Flue Lining
C1288—14:	Standard Specification for Discrete Nonasbestos Fiber-cement Interior Substrate Sheets
C1289—15:	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
C1325—14:	Standard Specification for Nonasbestos Fiber- mat Reinforced Cement Interior Substrate Sheets Backer Units
C1328/C1328M—12:	Specification for Plastic (Stucco) Cement
C1363—11:	The Standard Test Method for Thermal Performance of Building Materials and

ASTM ASTM 100 Ba	I International arr Harbor Drive, P.O. Box C700
West C	Conshohocken, PA 19428
Standard referenced	Title
	Envelope Assemblies by Means of a Hot Box
	Apparatus
C1364—10B:	Standard Specification for Architectural Cast
	Stone
C1396/C1396M—2014A:	Specification for Gypsum Board
C1405—15:	Standard Specification for Glazed Brick (Single
	Fired. Brick Units)
C1492—03(2009):	Specification for Concrete Roof Tile
C1513—2013:	Standard Specification for Steel Tapping Screws
	for Cold-formed Steel Framing Connections
C1634—15:	Standard Specification for Concrete Facing
	Brick
C1658/C1658M—13:	Standard Specification for Glass Mat Gypsum
	Panels
C1668—13a:	Standard Specification for Externally Applied
	Reflective Insulation Systems on Rigid Duct in
	Heating, Ventilation, and Air Conditioning
	(HVAC) Systems
C1670/1670M—16:	Standard Specification for Adhered
	Manufactured Stone Masonry Veneer Units
C1691—11:	Standard Specification for Unreinforced
	Autoclaved Aerated Concrete (AAC) Masonry
	Units
C1693—11:	Standard Specification for Autoclaved Aerated
	Concrete (AAC)
C1766—13:	Standard Specification for Factory-Laminated
	Gypsum Panel Products
D41/D41M—2011:	Specification for Asphalt Primer Used in
	Roofing, Dampproofing and Waterproofing
D43/D43M-2000(2012)E	1: Specification for Coal Tar Primer Used in
	Roofing, Dampproofing and Waterproofing
D226/D226M—09:	Specification for Asphalt-saturated (Organic
	Felt) Used in Roofing and Waterproofing
D227/D227M-03(2011)e	1: Specification for Coal Tar Saturated (Organic
	Felt) Used in Roofing and Waterproofing
D312/D321M—15:	Specification for Asphalt Used in Roofing
D422—63(2007)E2:	Test Method for Particle-size Analysis of Soils

ASTM ASTM Int	ernational
100 Barr F West Con	harbor Drive, P.O. Box C/00
Standard referenced	Title
D449/D449M_03(2014)F1	Specification for Asphalt Used in
	Dampproofing and Waterproofing
D450/D450M_07(2013)F1	Specification for Coal-tar Pitch Used in
D 130/D 130111 0/(2013)E1.	Roofing Dampproofing and Waterproofing
D1227—13·	Specification for Emulsified Asphalt Used as a
D1227 13.	Protective Coating for Roofing
D1248 12·	Specification for Polyethylene Plastics
D1240—12.	Extrusion Materials for Wire and Cable
D1603 15:	Test Mathod for Environmental Stress creating
D1070-10.	of Ethylana Diastics
D1784 11	Standard Specification for Digid Doly (Viny)
D1/84—11.	Chlorida) (DVC) Compounds and Chloringtod
	Chloride) (PVC) Compounds and Chloridae
$D_{10}(2) D_{10}(2) M = 05(2011) - 1$	Poly (Vinyi Chiorde) (CPVC) Compounds
D1863/D1863M = 05(2011)e1:	Specification for Mineral Aggregate Used in
	Built-up Roofs
D1970/D1970M—2015A:	Specification for Self-adhering Polymer
	Modified Bitumen Sheet Materials Used as
	Steep Rooting
	Underlayment for Ice Dam Protection
D2178/D2178M—15:	Specification for Asphalt Glass Felt Used in
	Rooting and Waterprooting
D2412—11:	Test Method for Determination of External
	Loading Characteristics of Plastic Pipe by
	Parallel-plate Loading
D2447—03:	Specification for Polyethylene (PE) Plastic Pipe
	Schedules 40 and 80, Based on Outside
	Diameter
D2513—2014e1:	Specification for Gas Pressure Pipe, Tubing and
	Fittings
D2626/D2626M—04 (2012)e1:	Specification for Asphalt-saturated and Coated
	Organic Felt Base Sheet Used in Roofing
D2683—14:	Specification for Socket-type Polyethylene
	Fittings for Outside Diameter-controlled
	Polyethylene Pipe and Tubing
D2822/D2822M-05(2011)e1:	Specification for Asphalt Roof Cement,
. ,	Asbestos Containing

ASTM ASTM Int 100 Barr I	ernational Harbor Drive, P.O. Box C700
West Con	shohocken. PA 19428
Standard referenced	Title
D2823/D2823M—05(2011)e1:	Specification for Asphalt Roof Coatings, Asbestos Containing
D2824/D2824M—2013:	Specification for Aluminum-pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered and Fibered without Asbestos
D2898—10:	Test Methods for Accelerated Weathering of Fire-retardant-treated Wood for Fire Testing
D3019—08:	Specification for Lap Cement Used with Asphalt Roll Roofing, Nonfibered, Asbestos Fibered and Nonasbestos Fibered
D3161/D3161M—15:	Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan Induced Method)
D3201/D3201M—2013:	Test Method for Hygroscopic Properties of Fire- retardant Wood and Wood-base Products
D3309—96a(2002):	Specification for Polybutylene (PB) Plastic Hot- and Cold-water Distribution System
D3350—14:	Specification for Polyethylene Plastic Pipe and Fitting Materials
D3462/D3462M—10A:	Specification for Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules
D3468/D3468M—99(2013)E1:	Specification for Liquid-applied Neoprene and Chlorosulfanated Polyethylene Used in Roofing and Waterproofing
D3679—13:	Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding
D3737—2012:	Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam)
D3747—79(2007):	Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation
D3909/D3909M—14:	Specification for Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
D4022/D4022M—2007(2012)e1:	Specification for Coal Tar Roof Cement, Asbestos Containing
D4318—10E1:	Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils

ASTM ASTM In	ternational
100 Barr	Harbor Drive, P.O. Box C/00
Standard referenced	Title
D4434/D4434M—12:	Specification for Poly (Vinyl Chloride) Sheet Roofing
D4479/D4479M-07(2012)e1:	Specification for Asphalt Roof Coatings— asbestos-free
D4586/D4586M—07(2012)e1:	Specification for Asphalt Roof Cemen— asbestos-free
D4601/D4601M-04(2012)e1:	Specification for Asphalt-coated Glass Fiber Base Sheet Used in Roofing
D4637/D4637M—14E1:	Specification for EPDM Sheet Used in Single- ply Roof Membrane
D4829—11:	Test Method for Expansion Index of Soils
D4869/D4869M—15:	Specification for Asphalt-saturated (Organic Felt) Underlayment Used in Steep Slope
D4897/D4897M—01(2009):	Specification for Asphalt Coated Glass-fiber Venting Base Sheet Used in Roofing
D4990—1997a(2013):	Specification for Coal Tar Glass Felt Used in Roofing and Waterproofing
D5019—07a:	Specification for Reinforced Nonvulcanized Polymeric Sheet Used in Roofing Membrane
D5055—13E1:	Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I- ioists
D5456—14B:	Standard Specification for Evaluation of Structural Composite Lumber Products
D5516—09:	Test Method for Evaluating the Flexural Properties of Fire-retardant-treated Softwood Plywood Exposed to the Elevated Temperatures
D5643/D5643M—06(2012)e1:	Specification for Coal Tar Roof Cement Asbestos-free
D5664—10:	Test Methods For Evaluating the Effects of Fire-retardant Treatments and Elevated Temperatures on Strength Properties of Fire- retardant-treated Lumber
D5665/D5665M—99a(2014)E1:	Specification for Thermoplastic Fabrics Used in Cold-applied Roofing and Waterproofing

ASTM ASTM Int 100 Barr I	ternational Harbor Drive, P.O. Box C700
West Con	shohocken, PA 19428
Standard referenced	Title
D5726—98(2013):	Specification for Thermoplastic Fabrics Used in Hot-applied Roofing and Waterproofing
D6083—05e01:	Specification for Liquid-applied Acrylic Coating Used in Roofing
D6162/D6162M—2000a(2015)E1:	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
D6163/D6163M—2000(2015)E1:	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
D6164/D6164M—11:	Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
D6222/D6222M—11:	Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester
D6223/D6223M—02(2009)E1:	Reinforcements Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber
D6298—13:	Reinforcement Specification for Fiberglass-reinforced Styrene Butadiene Styrene (SBS) Modified Bituminous Sheets with a Factory Applied Metal Surface
D6305—08(2015)E1:	Practice for Calculating Bending Strength Design Adjustment Factors for Fire-retardant- treated Plywood Roof Sheathing
D6380/D6380-03(2013)E1:	Standard Specification for Asphalt Roll Roofing (Organic Felt)
D6464—03a(2009)e1:	Standard Specification for Expandable Foam Adhesives for Fastening Gypsum Wallboard to Wood Framing
D6694/D6694M—08(2013)E1:	Standard Specification for Liquid-applied Silicone Coating Used in Spray Polyurethane Foam Roofing Systems

ASTM ASTM International		
100 Barr Harbor Drive, P.O. Box C700		
West Con	shohocken, PA 19428	
Standard referenced	Title	
D6754/D6754M—10:	Standard Specification for Ketone-ethylene- ester-based Sheet Roofing	
D6757—2013:	Specification for Underlayment Felt Containing Inorganic Fibers Used with Steep Slope Roofing	
D6841—08:	Standard Practice for Calculating Design Value Treatment Adjustment Factors for Fire- retardant-treated Lumber	
D6878/D6878M—13:	Standard Specification for Thermoplastic- polyolefin-based Sheet Roofing	
D6947/D6947M—07(2013)E1:	Standard Specification for Liquid Applied Moisture Cured Polyurethane Coating Used in Spray Polyurethane Foam Poofing System	
D7032—14:	Standard Specification for Establishing Performance Ratings for Wood-plastic Composite Deck Boards and Guardrail Systems (Guards or Handrails)	
D7158—D7158M—2016:	Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)	
D7254—15:	Standard Specification for Polypropylene (PP) siding	
D7425/D7425M—13:	Standard Specification for Spray Polyurethane Foam Used for Roofing Application	
D7672—14:	Standard Specification for Evaluating Structural Capacities of Rim Board Products and Assemblies	
D7793—13:	Standard Specification for Insulated Vinyl Siding	
E84—2016:	Standard Test Method for Surface Burning Characteristics of Building Materials	
E96/E96M—2015:	Test Method for Water Vapor Transmission of Materials	
E108—2016:	Test Methods for Fire Tests of Roof Coverings	
E119—2016:	Test Methods for Fire Tests of Building Construction and Materials	

	A C'TN / T	tomational	
ASTM	ASIM International		
	West Carr	naruur Drive, P.U. BOX C/UU	
Ctan Jan Jan C	west Con	ISNONOCKEN, PA 19428	
Standard referenc	ed	Title	
E136—2016:		Test Method for Behavior of Materials in a	
		Vertical Tube Furnace at 750°C	
E283—04(2012):		Test Method for Determining the Rate of Air	
		Leakage through Exterior Windows, Curtain	
		Walls and Doors Under Specified Pressure	
		Differences across the Specimen	
E330/E330M—14:		Test Method for Structural Performance of	
		Exterior Windows, Curtain Walls and Doors by	
		Uniform Static Air Pressure Difference	
E331—00(2009):		Test Method for Water Penetration of Exterior	
		Windows, Skylights, Doors and Curtain Walls	
		by Uniform Static Air Pressure Difference	
E779—10:		Standard Test Method for Determining Air	
		Leakage Rate by Fan Pressurization	
E814—2013A:		Standard Test Method for Fire Tests of	
		Penetration Firestop Systems	
E970—14:		Standard Test Method for Critical Radiant Flux	
		of Exposed Attic Floor Insulation Using a	
		Radiant Heat Energy Source	
E1509—12:		Standard Specification for Room Heaters, Pellet	
		Fuel-burning Type	
E1602—03(2010)e	1:	Guide for Construction of Solid Fuel Burning	
		Masonry Heaters	
E1827—11:		Standard Test Methods for Determining	
		Airtightness of Building Using an Orifice	
		Blower Door	
E1886—13A:		Test Method for Performance Impact Protective	
		Systems Impacted by Missile(s) and Exposed to	
		Cyclic Pressure Differentials	
E1996—2014a:		Standard Specification for Performance of	
		Exterior Windows, Curtain Walls, Doors and	
		Impact Protective Systems Impacted by	
		Windborne Debris in Hurricanes	
E2178—2013:		Standard Test Method for Air Permeance of	
		Building Materials	

ASTM ASTM I	nternational
West Co	onshohocken PA 19428
Standard referenced	Title
E2231—15:	Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials
E2273—03(2011):	Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
E2568—09e1:	Standard Specification for PB Exterior Insulation and Finish Systems
E2570/E2570M—07(2014)E1	: Standard Test Methods for Evaluating Water- resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage
E2634—11(2015):	Standard Specification for Flat Wall Insulating Concrete Form (ICF) Systems
F844—07a(2013):	Standard Specification for Washers, Steel, Plain (Flat). Unhardened for General Use
F876—15A:	Specification for Cross-linked Polyethylene (PEX) Tubing
F877—2011A:	Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-water Distribution
F1055—13:	Systems Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked
F1281—11:	Polyethylene Pipe and Tubing Specification for Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Pressure Pipe
F1282—10:	Specification for Polyethylene/Aluminum/Polyethylene (PE-AL- PE) Composite Pressure Pipe
F1554—15:	Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength
F1667—15:	Specification for Driven Fasteners, Nails, Spikes and Staples
F1807—15:	Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked

A CIEN International		
ASTM	ASIM III 100 Barr	Harbor Drive P.O. Box C700
	West Con	shohocken PA 19/28
Standard reference	ad and	Title
Standard Telefener	u	Thue
		Polyethylene (PEX) Tubing and SDR9
		Polyethylene of Raised Temperature (PE-RT)
		Tubing
F1924—12:		Standard Specification for Plastic Mechanical
		Fittings for Use on Outside Diameter Controlled
		Polyethylene Gas Distribution Pipe and Tubing
F1960—15:		Specification for Cold Expansion Fittings with
		PEX Reinforcing Rings for Use with Cross-
		linked Polyethylene (PEX) Tubing
F1970—12E1:		Standard Specification for Special Engineered
		Fittings, Appurtenances or Valves for Use in
		Poly (Vinyl Chloride) (PVC) or Chlorinated
F1072 12F1		Poly (Vinyl Chloride) (CPVC) Systems
F19/3—13E1:		Standard Specification for Factory Assembled
		Anodeless Risers and Transition Fittings in Deliverbulence (DE) and Delivergide 11 (DA 11)
		Polyetnylene (PE) and Polyamide II (PA II)
E 2000 17.		Fuel Gas Distribution Systems
F 2090—17:		Specification for window Fail Prevention
		Devices with Emergency Escape (Egress)
E2000 00.		Standard Specification for Stainlage Steel
12090-00.		Clamps for Socuring SDP0 Cross linked
		Polyethylene (PEY) Tubing to Metal Insert and
		Plastic Insert Fittings
F238915·		Standard for Pressure-rated Polypropylene (PP)
12509 15.		Pining Systems
F2623—14:		Standard Specification for Polyethylene of
12020 111		Raised Temperature (PE-RT) SDRG Tubing
F2735—09:		Standard Specification for Plastic Insert Fittings
12,000 0,0		for SDR9 Cross-linked Polyethylene (PEX) and
		Polyethylene of Raised Temperature (PE-RT)
		Tubing
F2769—14:		Polyethylene or Raised Temperature (PE-RT)
·		Plastic Hot and Cold-Water Tubing and
		Distribution Systems

ASTM	ASTM In 100 Barr West Cor	ternational Harbor Drive, P.O. Box C700 oshobocken, PA 19428
Standard reference	ed	Title
F2806—10(2015):		Standard Specification for Acrylonitrile- butadiene-styrene (ABS) Plastic Pipe (Metric SDR-PR)
F2945—2015:		Standard Specification for Polyamide 11 Gas Pressure Pipe, Tubing and Fittings
F2969—12:		Standard Specification for Acrylonitrile- butadiene-styrene (ABS) IPS Dimensioned Pressure Pipe
	American	Wood Council
AWC	222 Catoo Leesburg	ctin Circle SE, Suite 201 VA 20175
Standard reference	ed	Title
AWC STJR—2015 ANSI/AWC WFCM	: Л—2018:	Span Tables for Joists and Rafters Wood Frame Construction Manual for One- and
ANSI/AWC NDS-	-2018:	Two-family Dwellings National Design Specification (NDS) for Wood Construction—with 2018 Supplement
ANSI/AWC PWF-	-2015:	Permanent Wood Foundation Design Specification
AWPA	American P.O. Box Birmingh	Wood Protection Association 361784 am, AL 35236-1784
Standard reference	ed	Title
C1—03:		All Timber Products—Preservative Treatment by Pressure Processes
M4—16:		Standard for the Care of Preservative-treated Wood Products
U1—16:		USE CATEGORY SYSTEM: User Specification for Treated Wood Except Commodity Specification H

AWS	American Welding Society		
	8669 NW	7 36 Street, #130	
	Miami, F	L 33166	
Standard referenc	ed	Title	
ANSI/AWS A5.31M/A5.31—20	012:	Specification for Fluxes for Brazing and Braze Welding Edition: 2nd	
AWWA	American	n Water Works Association	
	6666 We	st Quincy Avenue	
	Denver, O	CO 80235	
Standard referenc	ed	Title	
C903—16:		Polyethylene-aluminum-polyethylene (PE-AL- PE) Composite Pressure Pipe, 12 mm ($^{1}/_{2}$ in.) through 50 mm (2 in.), for Water Service	
CEN	European Central S Rue de S B-10 50 J	Committee for Standardization (EN) ecretariat tassart 36 Brussels	
Standard referenc	ed	Title	
EN 15250-2007:		Slow Heat Release Appliances Fired by Solid Fuel Requirements and Test Methods	
СРА	Composi	te Panel Association	
0111	19465 De	eerfield Avenue, Suite 306	
	Leesburg	, VA 20176	
Standard referenc	ed	Title	
ANSI A135.4—201	12:	Basic Hardboard	
ANSI A 125 6 201	12:	Freinished Hardboard Paneling	
ANSI A 135.0-201	12:	Engineered Wood Sluing	
AINST A135. $/-201$	12:	Engineered wood Iriin	
A208.1—2016:		Paruciedoard	

CPSC	Consume 4330 Eas	er Product Safety Commission st-West Highway
	Bethesda	, MD 20814
Standard reference	ed	Title
16 CFR, Part 1201-	-(2002):	Safety Standard for Architectural Glazing
16 CFR, Part 1209-	-(2002):	Interim Safety Standard for Cellulose Insulation
16 CFR, Part 1404-	_(2002):	Cellulose Insulation
CSA	CSA Gro	
	8501 Eas	t Pleasant Valley Road
	Clevelan	d, OH 44131-5516
Standard reference	ed	Title
AAMA/WDMA/CS	SA	North American Fenestration Standard/
101/I.S.2/A440—1	7:	Specification for Windows, Doors and Unit
		Skylights
ANSI/CSA FC I—2	2014:	Fuel Cell Technologies—Part 3-100;
		Stationary fuel cell power systems-Safety
ASME A17.1/		Safety Code for Elevators and Escalators
CSA B44—2016:		•
CSA 8—93:		Requirements for Gas Fired Log Lighters for
		Wood Burning Fireplaces
B44—20 <i>16</i> :		Safety Code for Elevators and Escalators
B55.1—2015:		Test Method for Measuring Efficiency and Pressure
		Loss of Drain Water Heat Recovery Units
B55.2—2015:		Drain Water Heat Recovery Units
B137.9—16:		Polyethylene/Aluminum/Polyethylene (PE-AL-
		PE) Composite Pressure Pipe Systems
B137.10—13:		Cross-linked Polyethylene/Aluminum/Cross-
		linked Polyethylene (PE-AL-PE) Composite
		Pressure Pipe Systems
B137.18—13:		Polyethylene of Raised Temperature (PE-RT)
		Tubing Systems for Pressure Applications
C22.2 No. 218.1—		Spas, Hot Tubs and Associated Equipment
M89(R2011):		
C22.2 No. 236—15	:	Heating and Cooling Equipment
CSA C448 Series—	-16:	Design and Installation of Earth Energy Systems
CSA O325—07:		Construction Sheathing
O437-Series—93:		Standards on OSB and Waferboard (Reaffirmed 2006)

CSA	CSA Gro 8501 Eas	oup st Pleasant Valley Road
Standard referen	nced	Title
CAN/ CSA/_C22.2 60335-2-40— 201	2 No. <u>22022</u> :	Safety of Household and Similar Electrical Appliances, <u>-Safety-</u> Part 2-40: Particular Requirements for Electrical Heat Pumps, Air- Conditioners and Dehumidifiers
CSSB	Cedar Sh P.O. Box Sumas, V	ake & Shingle Bureau x 1178 VA 98295-1178
Standard referen	nced	Title
CSSB—97:		Grading and Packing Rules for Western Red Cedar Shakes and Western Red Shingles of the Cedar Shake and Shingle Bureau
DASMA	Door & A 1300 Sum Cleveland	ccess Systems Manufacturers Association International aner Avenue I, OH 44115-2851
Standard referen	nced	Title
105—2016: 108—2017:		Test Method for Thermal Transmittance and Air Infiltration of Garage Doors and Rolling Doors Standard Method for Testing Garage Doors, Rolling Doors and Flexible Doors; Determination
115—2016:		of Structural Performance Under Uniform Static Air Pressure Difference Standard Method for Testing Sectional Garage Doors, Rolling Doors and Flexible Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure
	United S	tatas Danartmant of Commorca
DOC	1401 Con Washing	nstitution Avenue, NW ton, DC 20230
Standard referen	nced	Title
PS 1—09:		Structural Plywood

PS 2—10:		Performance Standard for Wood-based
		Structural-use Panels
PS 20—05:		American Softwood Lumber Standard
DOTn	U.S. Dep	artment of Transportation
	1200 Nev	w Jersey Avenue SE
	East Buil	ding, 2nd floor
	Washing	ton, DC 20590
Standard referenc	ed	Title
49 CFR, Parts 192. 192.283 (b) (20	281(e) & 09):	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
FEMA	Federal E	Emergency Management Agency
	500 C St	reet SW
	Washing	ton, DC 20472
Standard referenc	ed	Title
FEMA TB-2-08:		Flood Damage-resistant Materials Requirements
FEMA TB-11-01:		Crawlspace Construction for Buildings Located
		in Special Flood Hazard Area
		•
FM	FM Appr	rovals
	Headqua	rters Office
	1151 Bos	ston-Providence Turnpike
	P.O. Box	9102
	Norwood	I, MA 02062
Standard referenc	ed	Title
4450—(1989):		Approval Standard for Class 1 Insulated Steel Deck Roofs—with Supplements through July 1992
4880—(2015):		Approval Standard for Class 1 Rating of Building
		Panels or Interior Finish Materials
GA	Gypsum	Association
011	6525 Bel	crest Road, Suite 480
	Hyattsvil	le, MD 20782
Standard referenc	ed	Title
GA-253—2016 [.]		Application of Gypsum Sheathing
2.1 200 2010.		

HPVA	Hardwoo	od Plywood & Veneer Association
	1825 Mi	chael Faraday Drive
~	Reston,	Virginia 20190
Standard refere	nced	Title
ANSI/HPVA HF	-1—2016:	American National Standard for Hardwood and Decorative Plywood
TTT 7 T	Home V	antilating Institute
HVI	1000 No	rth Rand Road Suite 214
	Waucond	1a. II 60084
Standard refere	nced	Title
916—09		Airflow Test Procedure
ICC	Internatio	onal Code Council, Inc.
	500 New	y Jersey Avenue NW
	6th Floor	r
	Washing	ton, DC 20001
Standard refere	nced	Title
ANSI/RESNET/	ICC 301—	Standard for the Calculation and Labeling of the
2014:		Energy Performance of Low-Rise Residential
		Buildings using the Energy Rating Index, March
		7, 2014, republished 2016
ANSI/RESNET/	ICC 380—	Standard for Testing Airtightness of Building
2016:		Enclosures, Airtightness of Heating and Cooling
		Air Distribution and Airflow of Mechanical
ICC/ANGLA117	1 00.	Ventilation Systems
ICC/ANSTATT/ ICC/400 = 17	.1—09.	Accessible and Usable Bundings and Facilities Standard on the Design and Construction of Log
ICC 400—17.		Standard on the Design and Construction of Log
ICC 500—14·		ICC/NSSA Standard on the Design and
100 500 11.		Construction of Storm Shelters
ICC 600—14:		Standard for Residential Construction in High-
		wind Regions
ICC 900/SRCC	300—2015:	Solar Thermal System Standard
ICC 901/SRCC	100—2015:	Solar Thermal Collector Standard
IEBC—18:		International Existing Building Code [®]
IECC—18:		International Energy Conservation Code [®]

ICC	International Code Council, Inc. 500 New Jersey Avenue NW 6th Floor
Standard refere	nced Title
IECC—06:	International Energy Conservation Code [®] for use
IFGC—18:	International Fuel Gas Code [®]
IEEE	Institute of Electrical and Electronic Engineers, Inc. 3 Park Avenue, 17th Floor New York, NY 10016-5997
Standard refere	nced Title
515.1—2012:	IEEE Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Trace Heating for Commercial Applications
ISO	International Organization for Standardization Chemin de Blandonnet 8 CP 401 1214 Vernier Geneva Switzerland
Standard refere	nced Title
8336—2009:	Fibre-cement Flat Sheets-product Specification and Test Methods
15874—2002:	Polypropylene Plastic Piping Systems for Hot and Cold Water Installations
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry 127 Park Street, NE Vienna, VA 22180
Standard refere	nced Title
SP-58—09:	Pipe Hangers and Supports—Materials, Design, Manufacture, Selection, Application and Installation

NAIMA	North American Insulation Manufacturers Association 11 Canal Center Plaza, Suite 101 Alexandria, VA 22314		
Standard refere	enced Title		
AH 116—09:	Fibrous Glass Duct Construction Standards, Fifth Edition		
	National Disc Destantion Association		
NFPA	1 Detter march Derk		
	$\frac{1}{2} \frac{1}{2} \frac{1}$		
Standard refere	Denced Title		
Standard Telefe			
13—16:	Standard for Installation of Sprinkler Systems		
13D—16:	Standard for the Installation of Sprinkler Systems in One- and Two-family Dwellings and Manufactured Homes		
13R—16:	Standard for the Installation of Sprinkler Systems		
	in Low-Rise Residential Occupancies		
30-15	Flammable and combustible liquids code		
31—16:	Standard for the Installation of Oil-burning		
	Equipment		
37-10	Standard for the installation and use of stationary combustion engines and gas turbines		
58—17:	Liquefied Petroleum Gas Code		
70— <u>1723</u> :	National Electrical Code (as modified in Chapter 34)		
72—16:	National Fire Alarm and Signaling Code		
85—15:	Boiler and Combustion Systems Hazards Code		
110-10	Standard for emergency and standby power systems		
111-10	Standard on stored electrical energy emergency		
	and standby power systems		
211—16:	Standard for Chimneys, Fireplaces, Vents and		
	Solid Fuel Burning Appliances		
259—18:	Standard for Test Method for Potential Heat of		
	Building Materials		
275—17:	Standard Method of Fire Tests for the Evaluation		
004 15	of Thermal Barriers		
286—15:	Standard Methods of Fire Tests for Evaluating		
	Contribution of Wall and Ceiling Interior Finish to		
501 17	Room Fire Growth		
501—17:	Standard on Manufactured Housing		

	National Fire Protection Association			
	1 Batterymarch Park			
	Ouincy, MA 02169-7471			
Standard referenc	ed	Title		
720—15:		Standard for the Installation of Carbon Monoxide (CO) Detectors and Warning Equipment		
853—15:		Standard on the Installation of Stationary Fuel Cell Power Systems		
	National Fenestration Rating Council, Inc.			
NFRC	6305 Ivy	vy Lane, Suite 140		
	Greenbe	lt, MD 20770		
Standard referenced		Title		
100—2017:		Procedure for Determining Fenestration Products <i>U</i> -Factors		
200—2017:		Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible		
400—2017:		Transmittance at Normal Incidence Procedure for Determining Fenestration Product Air Leakage		

NIGH	NCEL		
NSF	NSF International		
	789 N. Dixboro Road		
	P.O. Bo	x 130140	
	Ann Art	oor, MI 48105	
Standard reference	ed	Title	
14—2015:		Plastics Piping System Components and Related	
		Materials	
358-1—2014:	Polyethylene Pipe and Fittings for Wa		
		Ground Source "Geothermal" Heat Pump Systems	
358-2-2012:		Polypropylene Pipe and Fittings for Water-based	
2002 2012		Ground Source "Geothermal" Heat Pump Systems	
PCA	Portland	l Cement Association	
	5420 Ol	d Orchard Road	
	Skokie,	IL 60077	
Standard reference	ed	Title	

100—12:		Prescriptive Design of Exterior Concrete Walls for		
		EB241)		
SBCA	Structur	al Building Components Association		
	6300 En	terprise Lane		
Standard referen		1, W1 53/19 Title		
BCSI—2013 (Undeted Merch 2	015).	Building Component Safety Information Guide to		
(Updated March 2015):		Restraining & Bracing of Metal Plate Connected Wood Trusses		
CFS-BCSI-2008	:	Cold-formed Steel Building Component Safety		
		Information (CFSBCSI) Guide to Good Practice		
		for Handling, Installing & Bracing of Cold-formed		
FS100—12:		Standard Requirements for Wind Pressure		
		Resistance of Foam Plastic Insulating Sheathing		
		Used in Exterior Wall Covering Assemblies		
	<u>C1</u> () (
SMACNA	A021 La	tal & Air Conditioning Contractors National Assoc. Inc.		
	Chantilly	y, VA 22021		
Standard referen	ced	Title		
SMACNA—10:		Fibrous Glass Duct Construction Standards (2003)		
SMACNA/ANSI-	-2016:	HVAC Duct Construction Standards—		
		Metal and Flexible 4th Edition (ANSI) 2016		
TMC	The Ma	sonry Society		
1 1/15	105 Sou	ith Sunset Street, Suite Q		
	Longm	ont, CO 80501		
Standard referen	ced 7	Title		
402—2016:	E	Building Code Requirements for Masonry Structures		
403—2017:	Ι	Direct Design Handbook for Masonry Structures		
404—2016:	S	Standard for the Design of Architectural Cast Stone		
002-2016:	2	specification for Masonry Structures		

TPI	Truss Plate Institute 218 N. Lee Street, Suite 312		
Standard referen	Alexandria, VA 22314		
TPI 1—2014:	National Design Standard for Metal-plate- connected Wood Truss Construction		
UL	UL LLC 333 Pfingsten Road Northbrook II 60062		
Standard referen	aced Title		
17—2008:	Vent or Chimney Connector Dampers for Oil-fired Appliances—with revisions through September 2013		
55A—04:	Materials for Built-up Roof Coverings		
58—96:	Steel Underground Tanks for Flammable and		
80—2007:	Combustible Liquids—with Revisions through July 1998 Steel Tanks for Oil-burner Fuel— with revisions through January 2014		
103—2010:	Factory-built Chimneys for Residential Type and Building Heating Appliances—		
127—2011:	with revisions through July 2012 Factory-built Fireplaces— with revisions through May 2015		
174—04:	Household Electric Storage Tank Water Heaters— with revisions through April 2015		
180—2012:	Liquid-level Indicating Gauges for Oil Burner Fuels and Other Combustible Liquids		
181—05:	Factory-made Air Ducts and Air Connectors—with revisions through May 2003		
181A—2013:	Closure Systems for Use with Rigid Air Ducts and Air Connectors—		
181B—2013:	with revisions through December 1998 Closure Systems for Use with Flexible Air Ducts and Air Connectors—		
217—06:	with revisions through August 2003 Single- and Multiple-station Smoke Alarms— with revisions through October 2015		
263—2011:	Standards for Fire Test of Building Construction and Materials—with revisions through June 2015		
268—2009:	Smoke Detectors for Fire Alarm Systems		

UL U	UL LLC		
	333 Pfingsten Road		
1	Northbrook, IL 60062		
Standard referenced	1 Title		
325—02:	Door, Drapery, Gate, Louver and Window Operations and Systems—with revisions through May 2015		
343—2008:	Pumps for Oil-burning Appliances— with revisions through June 2013		
378—06:	Draft Equipment— with revisions through June 12, 2014		
441—10:	Gas Vents—with revisions through June 12, 2014		
507—99:	Standard for Electric Fans		
508—99:	Industrial Control Equipment—		
	with revisions through October 2013		
515—11:	Electrical Resistance Heat Tracing for Commercial		
	and Industrial Applications		
	Including Revisions through July 2015		
536—97:	Flexible Metallic Hose—		
	with revisions through December 2014		
641—2010:	Type L. Low-temperature Venting Systems—		
	with revisions through June 2013		
651—2011:	Schedule 40 and Schedule 80 Rigid PVC Conduit and		
	Fittings—with revisions through May 2014		
705—04:	Standard for Power Ventilators—		
	with revisions through December 2013		
723-08:	Standard for Test for Surface Burning Characteristics		
120 001	of Building Materials—		
	with revisions through August 2013		
726—95:	Oil-fired Boiler Assemblies—		
	with revisions through October 2013		
727—06:	Oil-fired Central Furnaces—		
,	with revisions through October 2013		
729—03:	Oil-fired Floor Furnaces—		
,	with revisions through October 2013		
730-03:	Oil-fired Wall Furnaces—		
	with revisions through October 2013		
732_95.	Oil-fired Storage Tank Water Heaters—		
152 95.	with revisions through October 2013		
737—2011:	Firenlaces Stoves		

UL	UL LLC		
	333 Pfingsten Road		
	Northbrook, IL 60062		
Standard reference	ed Title		
790—04:	Standard Test Methods for Fire Tests of Roof Coverings—with revisions through July 2014		
795—2011:	Commercial-industrial Gas Heating Equipment— with revisions through November 2013		
834—04:	Heating, Water Supply and Power Boilers— Electric—with revisions through December 2013		
842—07:	Valves for Flammable Fluids— with revisions through May 2015		
858—05:	Household Electric Ranges— with revisions through June 2015		
875—09:	Electric Dry-bath Heaters— with revisions through December 2013		
896—93:	Oil-burning Stoves— with revisions through November 2013		
923—2013:	Microwave Cooking Appliances— with revisions through June 2015		
959—2010:	Medium Heat Appliance Factory-built Chimneys— with revisions through June 2014		
1026—2012:	Electric Household Cooking and Food Serving Appliances—with revisions through August 2015		
1040—96:	Fire Test of Insulated Wall Construction— with revisions through October 2012		
1042—2009:	Electric Baseboard Heating Equipment— with revisions through September 2014		
1256—02:	Fire Test of Roof Deck Construction— with revisions through July 2013		
1261—01:	Electric Water Heaters for Pools and Tubs— with revisions through July 2012		
1479—03:	Fire Tests of Through-Penetration Firestops— with revisions through June 2015		
1482—2011:	Solid-Fuel-type Room Heaters— with revisions through August 2015		
1563—2009:	Standard for Electric Spas, Hot Tubs and Associated Equipment—with revisions through March 2015		
1618—09:	Wall Protectors, Floor Protectors, and Hearth Extensions—with revisions through October 2015		

UL I	UL LLC		
333	333 Pfingsten Road		
Nort	hbrook, IL 60062		
Standard referenced	Title		
1693—2010:	Electric Radiant Heating Panels and Heating Panel Sets—with revisions through October 2011		
1703—02:	Flat-plate Photovoltaic Modules and Panels— with revisions through October 2015		
1715—97:	Fire Test of Interior Finish Material— with revisions through January 2013		
1738—2010:	Venting Systems for Gas-burning Appliances, Categories II, III and IV— with revisions through November 2014		
1741—2010:	Inverters, Converters, Controllers and Interconnection System Equipment with Distributed Energy Resources— with revisions through January 2015		
1777—07:	Chimney Liners— with revisions through October 2015		
1897—12:	Uplift Tests for Roof Covering Systems— with revisions through September 2015		
1995— 2011<u>2015</u>:	Heating and Cooling Equipment— with revisions through July 2015		
1996—2009:	Electric Duct Heaters— with revisions through June 2014		
2034—08:	Standard for Single- and Multiple-station Carbon Monoxide Alarms—with revisions through March 2015		
2075—2013:	Standard for Gas and Vapor Detectors and Sensors		
2158A—2010:	Outline of Investigation for Clothes Dryer Transition Duct		
2200-15	Stationary engine generator assemblies		
2523—09:	Standard for Solid Fuel-fired Hydronic Heating Appliances, Water Heaters and Boilers— with revisions through February 2013		
2703—14:	Mounting Systems, Mounting Devices, Clamping/Retention Devices and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels		
9540—14:	Outline of Investigation for Energy Storage Systems and Equipment		
UL/CSA/ANCE	Standard for Household and Similar Electrical		
60335-2-40— <u>20122022</u> :	Appliances, <u>-Safety-</u> Part 2 <u>-40</u> :		

UL	UL LLC		
	333 Pfingsten Road		
	Northbrook, IL 60062		
Standard reference	red Title		
	Particular Requirements for Motor-compressors <u>Electrical Heat Pumps, Air-Conditioners and</u> <u>Dehumidifiers</u>		
ULC	ULC 13775 Commerce Parkway Richmond, BC V6V 2V4		
Standard reference	red Title		
CAN/ULC S 102.2—2010: Standard Methods for Test for Surface Burning Characteristics of Building Materials and Assemblies			
US-FTC United States-Federal Trade Commission 600 Pennsylvania Avenue NW Washington, DC 20580			
Standard reference	red Title		
CFR Title 16(2015): R-value Rule		
WDMA Window and Door Manufacturers Association 2025 M Street NW, Suite 800			
Standard reference	Title		
Stanuaru Telerenc			
AAMA/WDMA/C I.S2/A440—17: I.S. 11—13:	SA 101/ North American Fenestration Standard/ Specifications for Windows, Doors and Skylights Industry Standard Analytical Method for Design Pressure (DP) Ratings of Fenestration Products		
	World Millwork Alliance		
WMA	(formarky Association of Willwork Distributors Stondards AMD)		
	(IOI MENY ASSOCIATION OF MINIWORK DISTIDUTORS Standards AMD)		
	1004 / Kobert Trent Parkway		
	New Port Richey, FL 34655-4649		
Standard reference	ed Title		
ANSI WMA 100—	-2016: Standard Method of Determining Structural Performance Ratings of Side Hinged Exterior		

Door Systems and Procedures for Component Substitution

Effective:	3/1/2024
Five Year Review (FYR) Dates:	7/1/2024

CERTIFIED ELECTRONICALLY

Certification

01/29/2024

Date

Promulgated Under: Statutory Authority: Rule Amplifies: Prior Effective Dates: 119.03 3781.10(A)(1) 3781.01, 3781.06, 3781.10, 3781.11, 3791.04, 4740.14 05/27/2006, 01/01/2008, 03/31/2008 (Emer.), 06/24/2008, 01/01/2009, 01/01/2013, 07/01/2014, 01/01/2016, 01/01/2018, 07/01/2019



Mike DeWine, Governor Jon Husted, Lt. Governor Sherry Maxfield, Director

AMENDMENTS GROUP 101 – RESIDENTIAL CODE OF OHIO SUMMARY of CHANGES

Ohio Administrative	Paragraph/	Source of	Reason for Proposed Change
Code Rule Number	Section	Proposed Change	
4101:8-4-01	403.1.4.1	Petition 19-03	Brings back exceptions for frost . protection
4101:8-34-01	3401.1	BBS	Adopts by reference NFPA 70 and clarifies use multi-family requirements of NFPA 70 for three family dwellings.
	3401.1 – Item #1	BBS	Relocated current modification #1 to #2. New modification #1 retains GFCI protection for 15- and 20-amp branch circuits up to 125 volts only (not 250 volts.) Follows reformatting of 210.8(A)
	3401.1 - Item #2	BBS	Renumbered exception for garage door opener from #1 to #2
	3401.1 – Item #3	BBS	Section 210.8(D) of NFPA 70 is applicable. NFPA reorganized GFCI protection for specific appliances. See NFPA 70 section 422.5. No Ohio modifications needed.
		BBS	Follows reformatting of 210.8(F). GFCI protection not required on exterior outlets for listed hvac equipment
	3401.1 – Item #4	BBS	Section 210.12(A) is model standard language – no Ohio modifications to AFCI protection
		BBS	Added new Item #4 to delete requirement for surge protection @ feeder supplied distribution – NFPA Section 215.18
	3401.1 – Item #5	BBS	Deleted - NFPA reorganized 210.63 and 210.64 into new section 210.63. No Ohio modifications necessary
		BBS	Added new Item #5 to delete

Ohio Administrative Code Rule Number	Paragraph/ Section	Source of Proposed Change	Reason for Proposed Change
			requirement for surge protection @ service entrance – NFPA Section 230.67
4101:8-44-01	Referenced Codes	BBS	Updates plumbing code for dwellings to OAC Chapters 4101:8-1 through 15.
	AAMA	ICC Errata	Changes date of standard 711 from "16" to "13"
	ANCE	Petition #20-11 & Daikin request	Removes ANCE organization and listed standard after that organization withdrew from standard sponsorship
	ANSI	BBS	Removes staff note from standard A108.1B
	ANSI	2021 IRC	Changes date of standard LC1/CSA 6.26 from "13" to "18"
	ASCE	ICC Errata	Changes date of standard 32 from "17" to "01"
	ASHRAE	Petition #20-11 & Daikin request	Updates standards 34 to the 2022 edition
	CSA	Petition #20-11 & Daikin request	Updates standard C22.2 No. 60335-2-40 to the 2022 edition and updates the title
	NFPA	Petition #22-01	Updates standard 70 to the 2023 edition with Ch 34 amendments
	UL	Petition #20-11 & Daikin request	Updates standard 1995 to the 2015 edition and standard 60335-2- 40 to the 2022 edition and updates the title