

CITY OF WAYNE



Building Permit Packet Related Information

Last Updated July ~ 2021

FOUNDATIONS

R402.1.1 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.

R402.1.2 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.

R402.2 Concrete. Concrete shall have a minimum specified compressive strength of f'_c , as shown in Table R402.2. Concrete subject to moderate or severe weathering as indicated in Table R301.2(1) shall be air entrained as specified in Table R402.2. 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.

R402.2.1 Materials for concrete. Materials for concrete shall comply with the requirements of Section R608.5.1.

R402.3 Precast concrete. Precast concrete foundations shall be designed in accordance with Section R404.5 and shall be installed in accordance with the provisions of this code and the manufacturer's instructions.

R402.3.1 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.
2. 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 precast concrete foundation walls shall have a minimum concrete cover of $\frac{3}{4}$ inch (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.

R402.4 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 R403 FOOTINGS

R403.1 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 R301 and to transmit the resulting loads to the soil within the limitations as determined from the character of the soil. Footings shall be supported on undisturbed natural soils or engineered fill. Concrete footing shall be designed and constructed in accordance with the provisions of Section R403 or in accordance with ACI 332.

TABLE R402.2
MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE

| TYPE OR LOCATION OF CONCRETE CONSTRUCTION | MINIMUM SPECIFIED COMPRESSIVE STRENGTH ^a (f'_c) | | |
|--|--|--------------------------|--------------------------|
| | Weathering Potential ^b | | |
| | Negligible | Moderate | Severe |
| Basement walls, foundations and other concrete not exposed to the weather | 2,500 | 2,500 | 2,500 ^c |
| Basement slabs and interior slabs on grade, except garage floor slabs | 2,500 | 2,500 | 2,500 ^c |
| 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 R301.2(1) for weathering potential.

c. Concrete in these locations that is subject to freezing and thawing during construction shall be air-entrained 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 R402.2 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.

R403.1.1 Minimum size. The minimum width, W , and thickness, T , for concrete footings shall be in accordance with Tables R403.1(1) through R403.1(3) and Figure R403.1(1) or R403.1.3, as applicable. The footing width shall be based on the load-bearing value of the soil in accordance with Table R401.4.1. 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 R1001.2. The size of footings supporting piers and columns shall be based on the tributary load and allowable soil pressure in accordance with Table R401.4.1. Footings for wood foundations shall be in accordance with the details set forth in Section R403.2, and Figures R403.1(2) and R403.1(3). Footings for precast foundations shall be in accordance with the details set forth in Section R403.4, Table R403.4, and Figures R403.4(1) and R403.4(2).

R403.1.2 Continuous footing in Seismic Design Categories D_0 , D_1 and D_2 . Exterior walls of buildings located in Seismic Design Categories D_0 , D_1 and D_2 shall be supported by continuous solid or fully grouted masonry or concrete footings. Other footing materials or systems shall be designed in accordance with accepted engineering practice. Required interior *braced wall panels* in buildings located in Seismic Design Categories D_0 , D_1 and D_2 with plan dimensions greater than 50 feet (15 240 mm) shall be supported by continuous solid or fully grouted masonry or concrete footings in accordance with Section R403.1.3.4, except for two-story buildings in Seismic Design Category D_2 , in which all *braced wall panels*, interior and exterior, shall be supported on continuous foundations.

Exception: Two-story buildings shall be permitted to have interior *braced wall panels* supported on continuous foundations at intervals not exceeding 50 feet (15 240 mm) provided that:

1. The height of cripple walls does not exceed 4 feet (1219 mm).
2. First-floor braced wall panels are supported on doubled floor joists, continuous blocking or floor beams.
3. The distance between bracing lines does not exceed twice the building width measured parallel to the braced wall line.

R403.1.3 Footing and stem wall reinforcing in Seismic Design Categories D_0 , D_1 , and D_2 . Concrete footings located in Seismic Design Categories D_0 , D_1 and D_2 , as established in Table R301.2(1), shall have minimum reinforcement in accordance with this section and Figure R403.1.3. Reinforcement shall be installed with support and cover in accordance with Section R403.1.3.5.

R403.1.3.1 Concrete stem walls with concrete footings. In Seismic Design Categories D_0 , D_1 and D_2 where a construction joint is created between a concrete footing and a concrete stem wall, not fewer than one No. 4 vertical bar shall be installed at not more than 4 feet (1219 mm) on center. The vertical bar shall have a standard hook and extend to the bottom of the footing and shall have support and cover as specified in Section

R403.1.3.5.3 and extend not less than 14 inches (357 mm) into the stem wall. Standard hooks shall comply with Section R608.5.4.5. Not fewer than one No. 4 horizontal bar shall be installed within 12 inches (305 mm) of the top of the stem wall and one No. 4 horizontal bar shall be located 3 to 4 inches (76 mm to 102 mm) from the bottom of the footing.

R403.1.3.2 Masonry stem walls with concrete footings. In Seismic Design Categories D_0 , D_1 and D_2 where a masonry stem wall is supported on a concrete footing, not fewer than one No. 4 vertical bar shall be installed at not more than 4 feet (1219 mm) on center. The vertical bar shall have a standard hook and extend to the bottom of the footing and shall have support and cover as specified in Section R403.1.3.5.3 and extend not less than 14 inches (357 mm) into the stem wall. Standard hooks shall comply with Section R608.5.4.5. Not fewer than one No. 4 horizontal bar shall be installed within 12 inches (305 mm) of the top of the wall and one No. 4 horizontal bar shall be located 3 to 4 inches (76 mm to 102 mm) from the bottom of the footing. Masonry stem walls shall be solid grouted.

R403.1.3.3 Slabs-on-ground with turned-down footings. In Seismic Design Categories D_0 , D_1 and D_2 , slabs-on-ground cast monolithically with turned-down footings shall have not fewer than one No. 4 bar at the top and the bottom of the footing or one No. 5 bar or two No. 4 bars in the middle third of the footing depth.

Where the slab is not cast monolithically with the footing, No. 3 or larger vertical dowels with standard hooks on each end shall be installed at not more than 4 feet (1219 mm) on center in accordance with Figure R403.1.3, Detail 2. Standard hooks shall comply with Section R608.5.4.5.

R403.1.3.4 Interior bearing and braced wall panel footings in Seismic Design Categories D_0 , D_1 and D_2 . In Seismic Design Categories D_0 , D_1 and D_2 , interior footings supporting bearing walls or *braced wall panels*, and cast monolithically with a slab on *grade*, shall extend to a depth of not less than 12 inches (305 mm) below the top of the slab.

R403.1.3.5 Reinforcement. Footing and stem wall reinforcement shall comply with Sections R403.1.3.5.1 through R403.1.3.5.4.

R403.1.3.5.1 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. The minimum yield strength of reinforcing steel shall be 40,000 psi (Grade 40) (276 MPa).

R403.1.3.5.2 Location of reinforcement in wall. The center of vertical reinforcement in stem walls shall be located at the centerline of the wall. Horizontal and vertical reinforcement shall be located in footings and stem walls to provide the minimum cover required by Section R403.1.3.5.3.

FOUNDATIONS

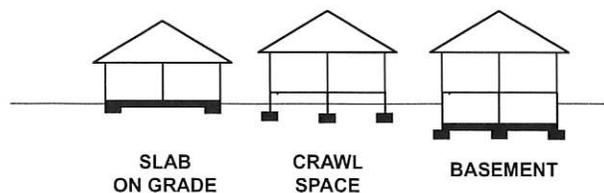
TABLE R403.1(1)
MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION (inches)^{a, b}

| SNOW LOAD OR ROOF LIVE LOAD | STORY AND TYPE OF STRUCTURE WITH LIGHT FRAME | LOAD-BEARING VALUE OF SOIL (psf) | | | | | |
|-----------------------------|--|----------------------------------|--------|--------|--------|--------|--------|
| | | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 |
| 20 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 16 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 22 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 25 × 8 | 19 × 6 | 15 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| 30 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 17 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 23 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 26 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| 50 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 16 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 21 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 25 × 7 | 19 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 17 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 22 × 6 | 17 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 28 × 9 | 21 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| 70 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 18 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 24 × 7 | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 16 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 21 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 27 × 9 | 20 × 6 | 16 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 25 × 7 | 18 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 30 × 10 | 23 × 6 | 18 × 6 | 15 × 6 | 13 × 6 | 12 × 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).



FOUNDATIONS

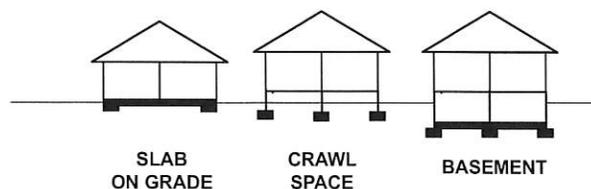
TABLE R403.1(2)
MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS FOR LIGHT-FRAME CONSTRUCTION WITH BRICK VENEER (inches)^{a, b}

| SNOW LOAD OR ROOF LIVE LOAD | STORY AND TYPE OF STRUCTURE WITH BRICK VENEER | LOAD-BEARING VALUE OF SOIL (psf) | | | | | |
|-----------------------------|---|----------------------------------|--------|--------|--------|--------|--------|
| | | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 |
| 20 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 21 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 26 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 26 × 8 | 19 × 6 | 15 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 32 × 11 | 24 × 7 | 19 × 6 | 16 × 6 | 14 × 6 | 12 × 6 |
| 30 psf | 1 story—slab-on-grade | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 16 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 22 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 16 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 22 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 27 × 9 | 21 × 6 | 16 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 21 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 27 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 33 × 11 | 24 × 7 | 20 × 6 | 16 × 6 | 14 × 6 | 12 × 6 |
| 50 psf | 1 story—slab-on-grade | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 24 × 7 | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 24 × 7 | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 29 × 10 | 22 × 6 | 18 × 6 | 15 × 6 | 13 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 27 × 7 | 18 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 29 × 9 | 22 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—plus basement | 35 × 12 | 26 × 8 | 21 × 6 | 17 × 6 | 15 × 6 | 13 × 6 |
| 70 psf | 1 story—slab-on-grade | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 26 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on grade | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 26 × 8 | 19 × 6 | 15 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 32 × 11 | 24 × 7 | 19 × 6 | 16 × 6 | 14 × 6 | 12 × 6 |
| | 3 story—slab-on-grade | 26 × 8 | 19 × 6 | 15 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 3 story—with crawl space | 31 × 11 | 23 × 7 | 19 × 6 | 16 × 6 | 13 × 6 | 12 × 6 |
| | 3 story—plus basement | 37 × 13 | 28 × 9 | 22 × 6 | 18 × 6 | 16 × 6 | 14 × 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).



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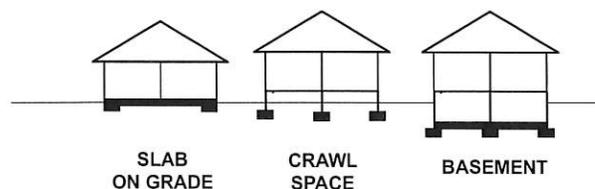
TABLE R403.1(3)
MINIMUM WIDTH AND THICKNESS FOR CONCRETE FOOTINGS
WITH CAST-IN-PLACE CONCRETE OR FULLY GROUTED MASONRY WALL CONSTRUCTION (inches)^{a, b}

| SNOW LOAD OR ROOF LIVE LOAD | STORY AND TYPE OF STRUCTURE WITH CMU | LOAD-BEARING VALUE OF SOIL (psf) | | | | | |
|-----------------------------|--------------------------------------|----------------------------------|---------|---------|--------|--------|--------|
| | | 1500 | 2000 | 2500 | 3000 | 3500 | 4000 |
| 20 psf | 1 story—slab-on-grade | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 25 × 8 | 19 × 6 | 15 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 23 × 7 | 18 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 29 × 9 | 22 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—plus basement | 35 × 12 | 26 × 8 | 21 × 6 | 17 × 6 | 15 × 6 | 13 × 6 |
| | 3 story—slab-on-grade | 32 × 11 | 24 × 7 | 19 × 6 | 16 × 6 | 14 × 6 | 12 × 6 |
| | 3 story—with crawl space | 38 × 14 | 28 × 9 | 23 × 6 | 19 × 6 | 16 × 6 | 14 × 6 |
| | 3 story—plus basement | 43 × 17 | 33 × 11 | 26 × 8 | 22 × 6 | 19 × 6 | 16 × 6 |
| 30 psf | 1 story—slab-on-grade | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 20 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 26 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 24 × 7 | 18 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 30 × 10 | 22 × 6 | 18 × 6 | 15 × 6 | 13 × 6 | 12 × 6 |
| | 2 story—plus basement | 36 × 13 | 27 × 8 | 21 × 6 | 18 × 6 | 15 × 6 | 13 × 6 |
| | 3 story—slab-on-grade | 33 × 12 | 25 × 7 | 20 × 6 | 17 × 6 | 14 × 6 | 12 × 6 |
| | 3 story—with crawl space | 39 × 14 | 29 × 9 | 23 × 7 | 19 × 6 | 17 × 6 | 14 × 6 |
| | 3 story—plus basement | 44 × 17 | 33 × 12 | 27 × 8 | 22 × 6 | 19 × 6 | 17 × 6 |
| 50 psf | 1 story—slab-on-grade | 17 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 22 × 6 | 17 × 6 | 13 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 28 × 9 | 21 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 27 × 8 | 20 × 6 | 16 × 6 | 13 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 32 × 11 | 24 × 7 | 19 × 6 | 16 × 6 | 14 × 6 | 12 × 6 |
| | 2 story—plus basement | 38 × 14 | 28 × 9 | 23 × 6 | 19 × 6 | 16 × 6 | 14 × 6 |
| | 3 story—slab-on-grade | 35 × 13 | 27 × 8 | 21 × 6 | 18 × 6 | 15 × 6 | 13 × 6 |
| | 3 story—with crawl space | 41 × 15 | 31 × 10 | 24 × 7 | 20 × 6 | 17 × 6 | 15 × 6 |
| | 3 story—plus basement | 47 × 18 | 35 × 12 | 28 × 9 | 23 × 7 | 20 × 6 | 17 × 6 |
| 70 psf | 1 story—slab-on-grade | 19 × 6 | 14 × 6 | 12 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—with crawl space | 25 × 7 | 18 × 6 | 15 × 6 | 12 × 6 | 12 × 6 | 12 × 6 |
| | 1 story—plus basement | 30 × 10 | 23 × 6 | 18 × 6 | 15 × 6 | 13 × 6 | 12 × 6 |
| | 2 story—slab-on-grade | 29 × 9 | 22 × 6 | 17 × 6 | 14 × 6 | 12 × 6 | 12 × 6 |
| | 2 story—with crawl space | 34 × 12 | 26 × 8 | 21 × 6 | 17 × 6 | 15 × 6 | 13 × 6 |
| | 2 story—plus basement | 40 × 15 | 30 × 10 | 24 × 7 | 20 × 6 | 17 × 6 | 15 × 6 |
| | 3 story—slab-on-grade | 38 × 14 | 28 × 9 | 23 × 6 | 19 × 6 | 16 × 6 | 14 × 6 |
| | 3 story—with crawl space | 43 × 16 | 32 × 11 | 26 × 8 | 21 × 6 | 18 × 6 | 16 × 6 |
| | 3 story—plus basement | 49 × 19 | 37 × 13 | 29 × 10 | 24 × 7 | 21 × 6 | 18 × 6 |

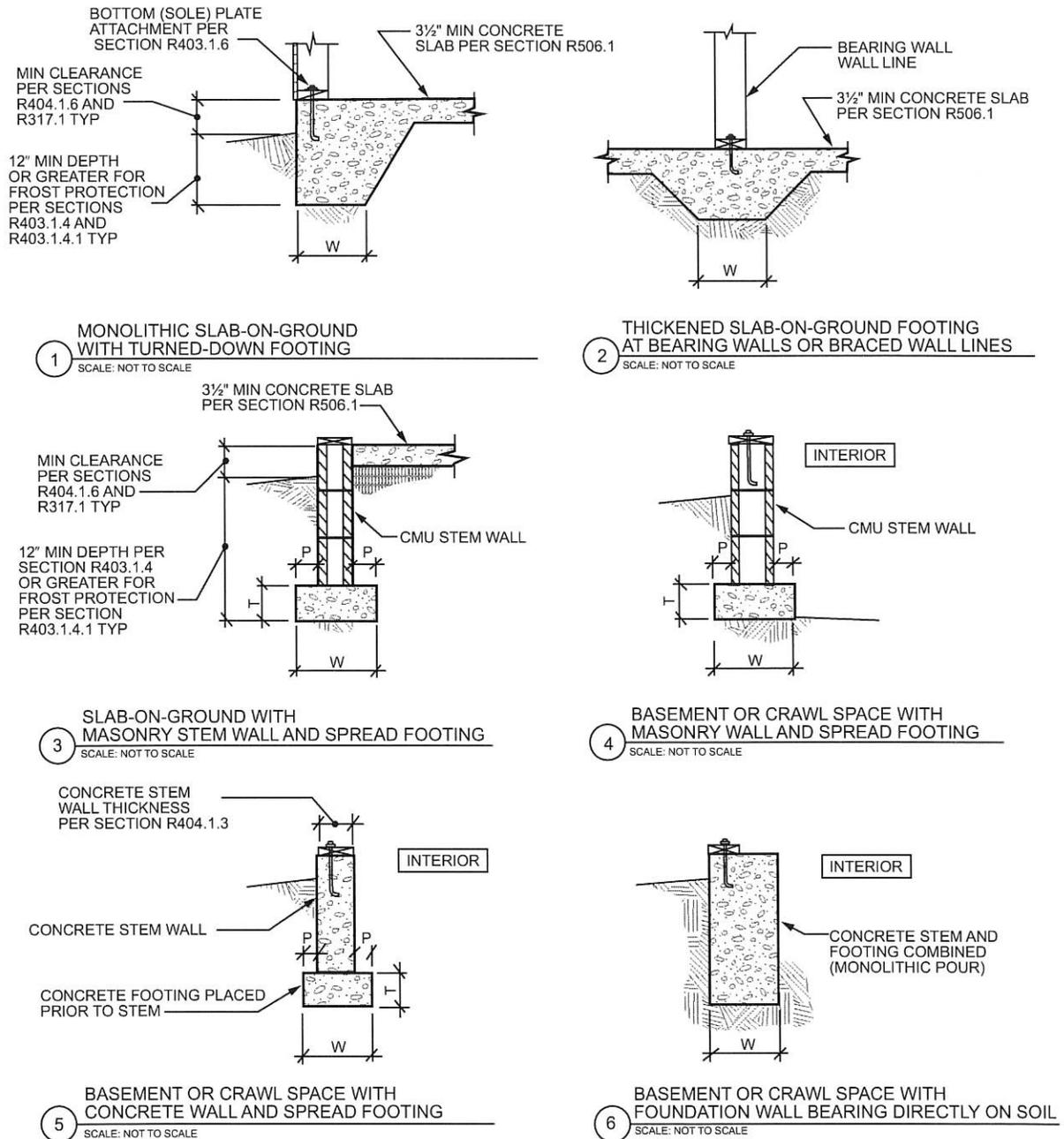
For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m, 1 pound per square foot = 47.9 N/m².

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).



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For SI: 1 inch = 25.4 mm.

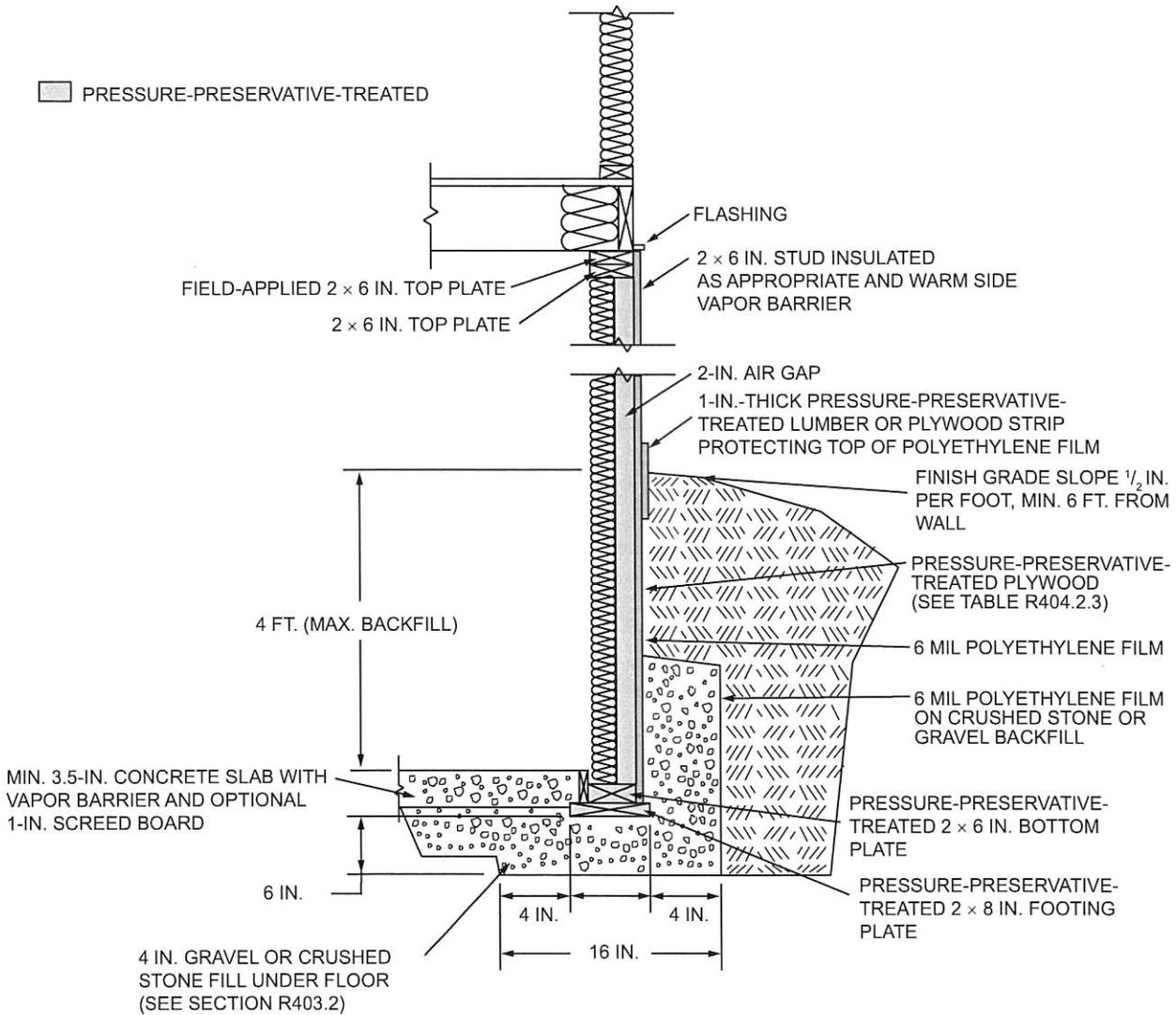
W = Width of footing, T = Thickness of footing and P = Projection per Section R403.1.1

NOTES:

- See Section R404.3 for sill requirements.
- See Section R403.1.6 for sill attachment.
- See Section R506.2.3 for vapor barrier requirements.
- See Section R403.1 for base.
- See Figure R403.1.3 for additional footing requirements for structures in SDC D₀, D₁ and D₂ and townhouses in SDC C.
- See Section R408 for under-floor ventilation and access requirements.

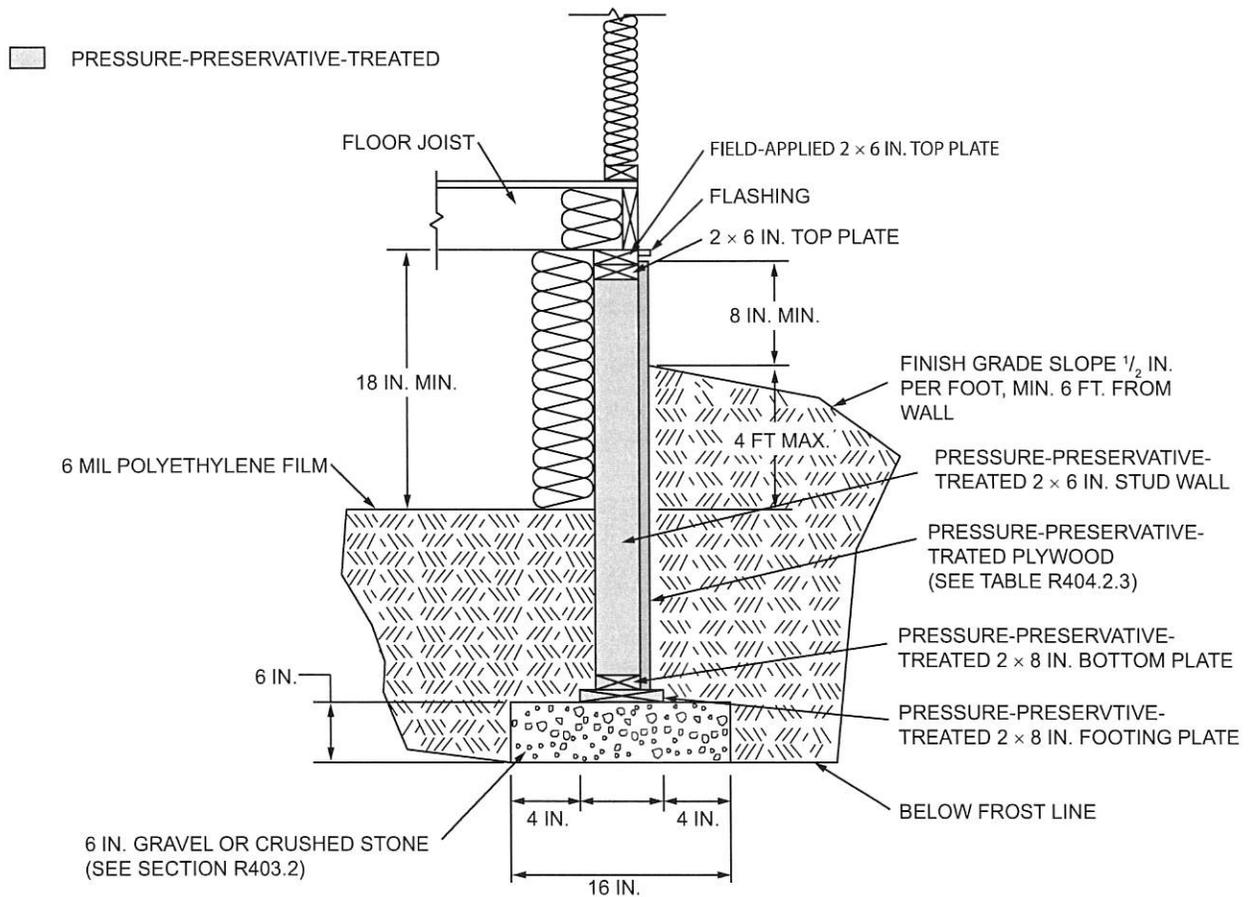
FIGURE R403.1(1)
PLAIN CONCRETE FOOTINGS WITH MASONRY AND CONCRETE STEM WALLS IN SDC A, B AND C^{a, b, c, d, e, f}

FOUNDATIONS



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

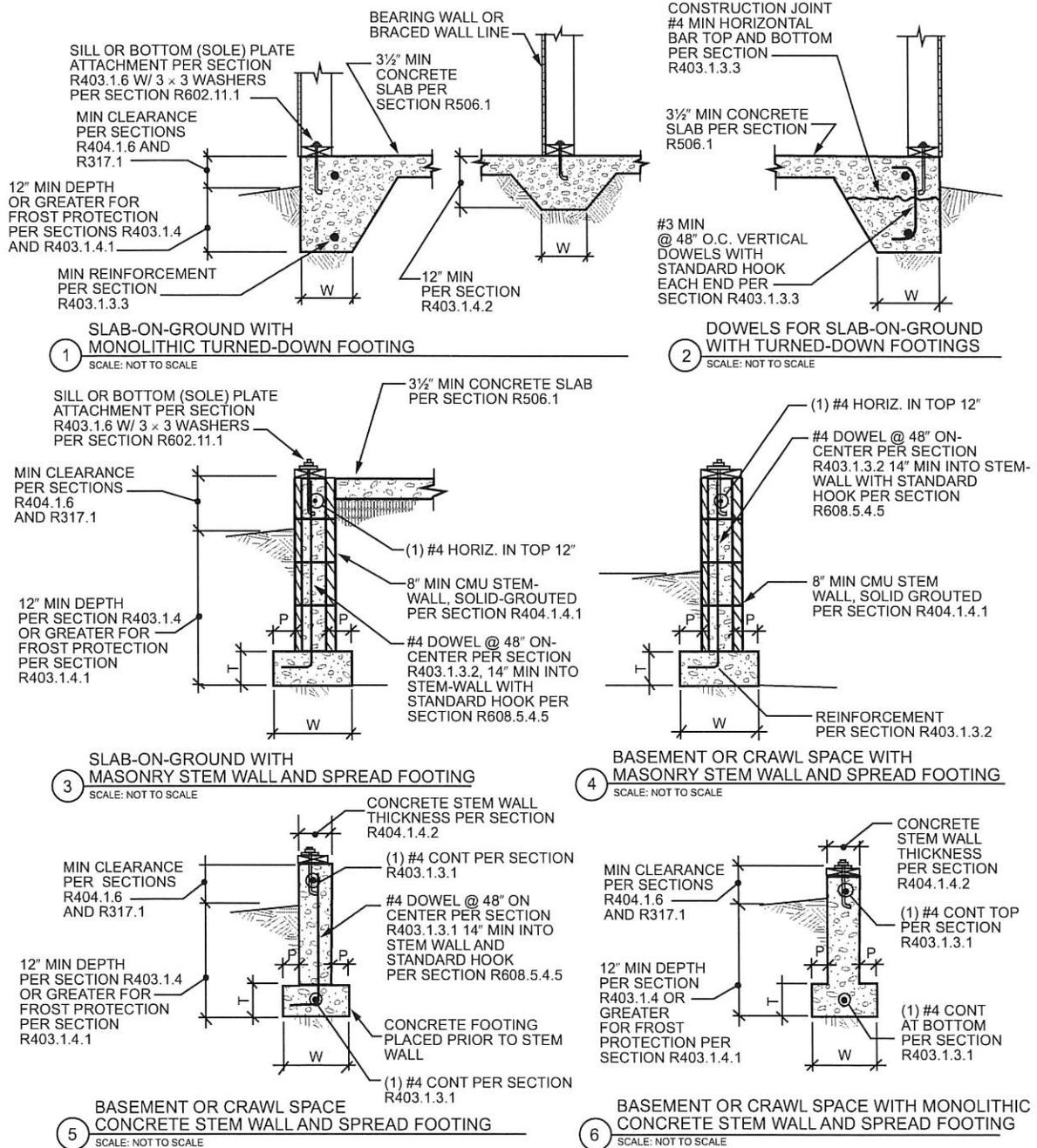
FIGURE R403.1(2)
PERMANENT WOOD FOUNDATION BASEMENT WALL SECTION



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

FIGURE R403.1(3)
PERMANENT WOOD FOUNDATION CRAWL SPACE SECTION

FOUNDATIONS



W = Width of footing, T = Thickness of footing and P = Projection per Section R403.1.1

NOTES:

- a. See Section R404.3 for sill requirements.
- b. See Section R403.1.6 for sill attachment.
- c. See Section R506.2.3 for vapor barrier requirements.
- d. See Section R403.1 for base.
- e. See Section R408 for under-floor ventilation and access requirements.
- f. See Section R403.1.3.5 for reinforcement requirements.

FIGURE R403.1.3
REINFORCED CONCRETE FOOTINGS AND MASONRY AND CONCRETE STEM WALLS IN SDC_D, D₁ AND D₂^{a, b, c, d, e, f}

R403.1.3.5.3 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 1½ 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 ¾ inch (19 mm).

R403.1.3.5.4 Lap splices. Vertical and horizontal reinforcement shall be the longest lengths practical. Where splices are necessary in reinforcement, the length of lap splice shall be in accordance with Table R608.5.4.(1) and Figure R608.5.4(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 R608.5.4(1)].

R403.1.3.6 Isolated concrete footings. In detached one- and two-family dwellings that are three stories or less in height and constructed with stud bearing walls, isolated plain concrete footings supporting columns or pedestals are permitted.

R403.1.4 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 R403.1.4.1 through R403.1.4.2.

R403.1.4.1 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 R301.2.(1).
2. Constructed in accordance with Section R403.3.
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.

Exceptions:

1. Protection of free-standing *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 shall not be required.
2. Protection of free-standing *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 shall not be required.

3. Decks not supported by a dwelling need not be provided with footings that extend below the frost line.

R403.1.5 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).

R403.1.6 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 R505.3.1 or R603.3.1, 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 ½-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 ½-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. The bolts shall be located in the middle third of the width of the plate. 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 R317 and R318.

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 R602.3(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 R602.3(1).

FOUNDATIONS

R403.1.6.1 Foundation anchorage in Seismic Design Categories C, D₀, D₁ and D₂. In addition to the requirements of Section R403.1.6, the following requirements shall apply to wood light-frame structures in Seismic Design Categories D₀, D₁ and D₂ and wood light-frame townhouses in Seismic Design Category C.

1. Plate washers conforming to Section R602.11.1 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*.
2. 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 R602.11.2.
6. Where continuous wood foundations in accordance with Section R404.2 are used, the force transfer shall have a capacity equal to or greater than the connections required by Section R602.11.1 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 R602.3(1).

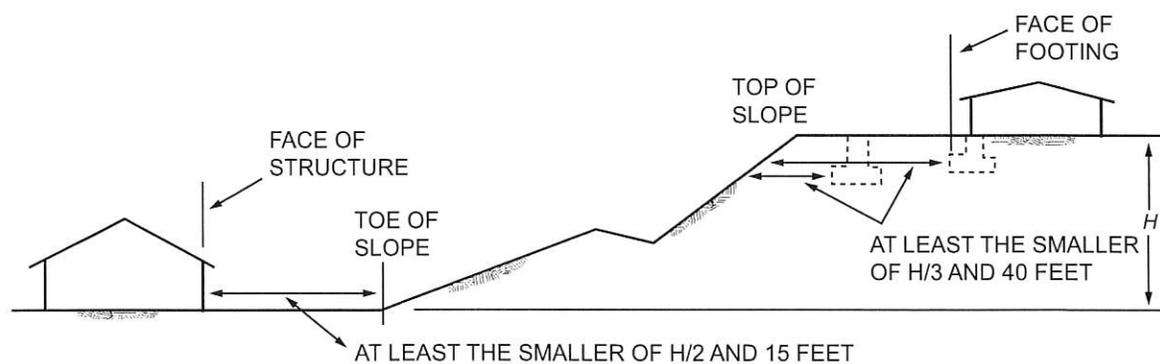
R403.1.7 Footings on or adjacent to slopes. The placement of buildings and structures on or adjacent to slopes steeper than one unit vertical in three units horizontal

(33.3-percent slope) shall conform to Sections R403.1.7.1 through R403.1.7.4.

R403.1.7.1 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 R403.1.7.4 and Figure R403.1.7.1, 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 toe of the slope, the height of the slope shall be measured from the top of the wall to the top of the slope.

R403.1.7.2 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 R403.1.7.4 and Figure R403.1.7.1, 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.

R403.1.7.3 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.



For SI: 1 foot = 304.8 mm.

FIGURE R403.1.7.1
FOUNDATION CLEARANCE FROM SLOPES

R403.1.7.4 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.

R403.1.8 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 *International 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*.

R403.1.8.1 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 μm), 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.

R403.2 Footings for wood foundations. Footings for wood foundations shall be in accordance with Figures R403.1(2) and R403.1(3). Gravel shall be washed and well graded. The maximum size stone shall not exceed $\frac{3}{4}$ inch (19.1 mm). Gravel shall be free from organic, clayey or silty soils. Sand shall be coarse, not smaller than $\frac{1}{16}$ -inch (1.6 mm) grains and shall be free from organic, clayey or silty soils. Crushed stone shall have a maximum size of $\frac{1}{2}$ inch (12.7 mm).

R403.3 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 R403.3(1) and Table R403.3(1). Foundations protected from frost in accordance with Figure R403.3(1) and Table R403.3(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°F (18°C).

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

R403.3.1 Foundations adjoining frost-protected shallow foundations. Foundations that adjoin frost-protected

shallow foundations shall be protected from frost in accordance with Section R403.1.4.

R403.3.1.1 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 R403.3(3) and Table R403.3(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.

R403.3.1.2 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°F (18°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 R403.3(4) a distance of not less than Dimension A in Table R403.3(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.

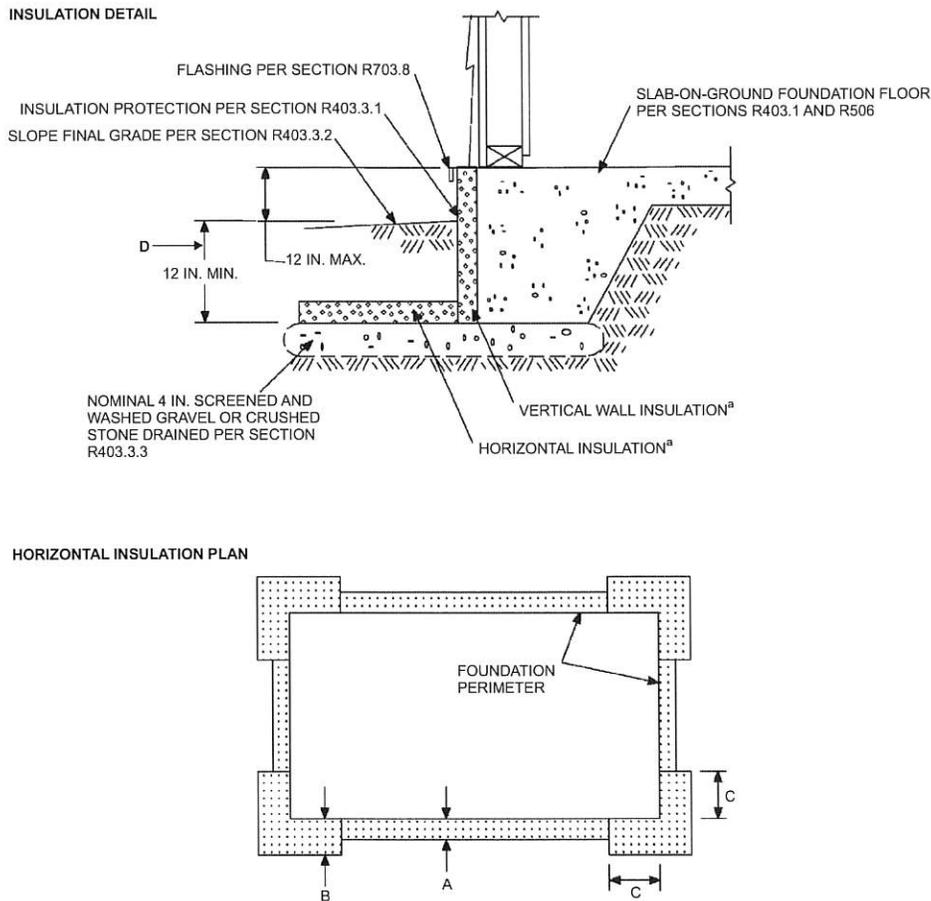
R403.3.2 Protection of horizontal insulation below ground. Horizontal insulation placed less than 12 inches (305 mm) below the ground surface or that portion of horizontal insulation extending outward more than 24 inches (610 mm) from the foundation edge shall be protected against damage by use of a 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.

R403.3.3 Drainage. Final *grade* shall be sloped in accordance with Section R401.3. In other than Group I Soils, as detailed in Table R405.1, gravel or crushed stone beneath horizontal insulation below ground shall drain to daylight or into an *approved* sewer system.

R403.3.4 Termite protection. The use of foam plastic in areas of “very heavy” termite infestation probability shall be in accordance with Section R318.4.

R403.4 Footings for precast concrete foundations. Footings for precast concrete foundations shall comply with Section R403.4.

FOUNDATIONS



For SI: 1 inch = 25.4 mm.

a. See Table R403.3(1) for required dimensions and R-values for vertical and horizontal insulation and minimum footing depth.

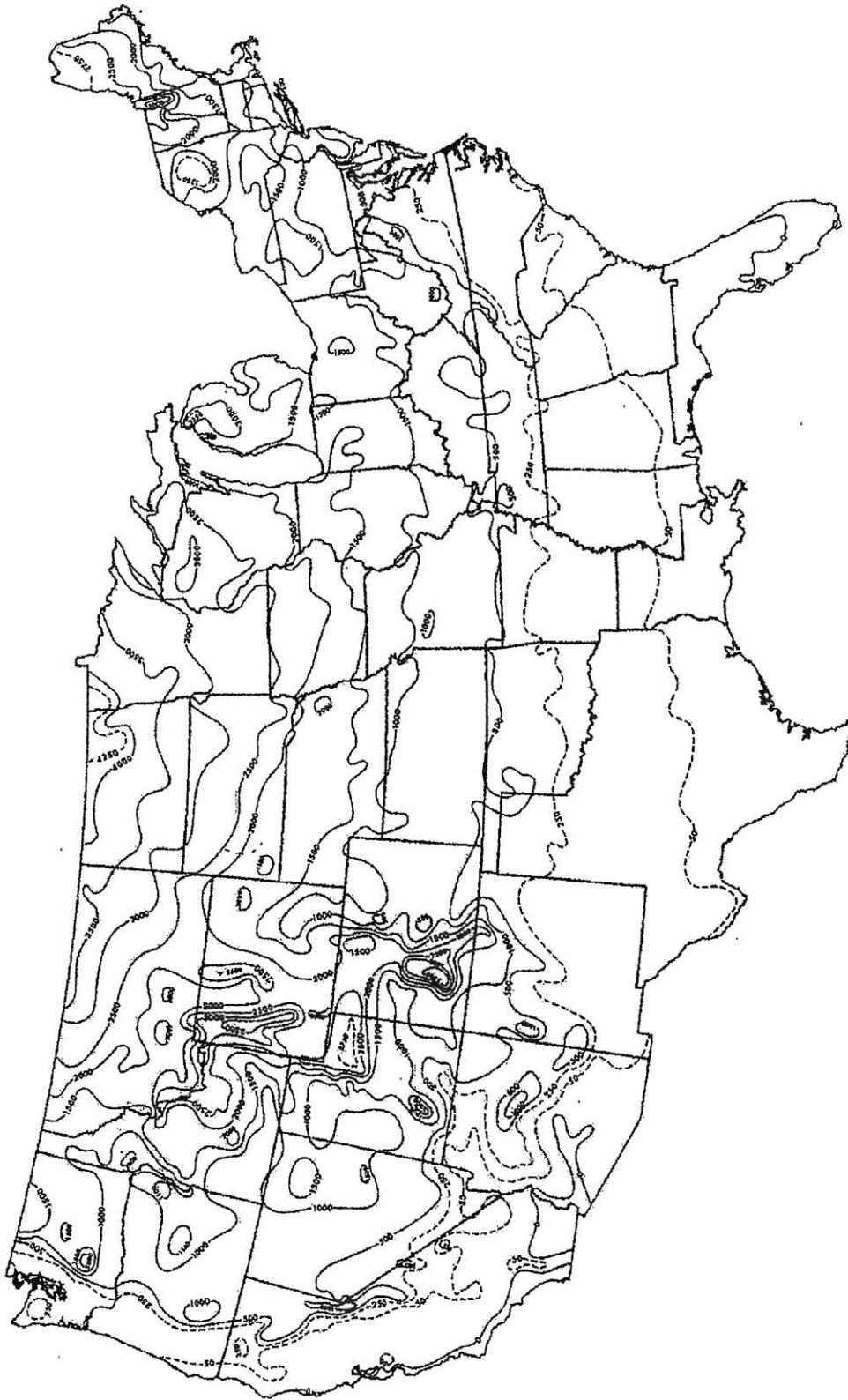
FIGURE R403.3(1)
INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS

TABLE R403.3(1)
MINIMUM FOOTING DEPTH AND INSULATION REQUIREMENTS FOR FROST-PROTECTED FOOTINGS IN HEATED BUILDINGS^a

| AIR FREEZING INDEX (°F-days) ^b | MINIMUM FOOTING DEPTH, D (inches) | VERTICAL INSULATION R-VALUE ^{c, d} | HORIZONTAL INSULATION R-VALUE ^{e, f} | | HORIZONTAL INSULATION DIMENSIONS PER FIGURE R403.3(1) (inches) | | |
|---|-----------------------------------|---|---|--------------|--|--------------|--------------|
| | | | Along walls | At corners | A | B | C |
| 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 |
| 2,500 | 16 | 6.7 | 1.7 | 4.9 | 12 | 24 | 40 |
| 3,000 | 16 | 7.8 | 6.5 | 8.6 | 12 | 24 | 40 |
| 3,500 | 16 | 9.0 | 8.0 | 11.2 | 24 | 30 | 60 |
| 4,000 | 16 | 10.1 | 10.5 | 13.1 | 24 | 36 | 60 |

For SI: 1 inch = 25.4 mm, °C = [(°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 R403.3(2) or Table R403.3(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: $^{\circ}\text{C} = ({}^{\circ}\text{F} - 32) / 1.8$.
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 R403.3(2)
 AIR-FREEZING INDEX AN ESTIMATE OF THE 100-YEAR RETURN PERIOD

FOUNDATIONS

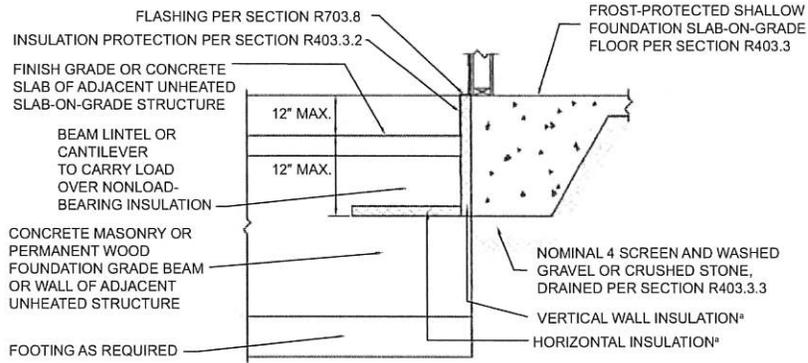
TABLE R403.3(2)—continued
AIR-FREEZING INDEX FOR U.S. LOCATIONS BY COUNTY

| STATE | AIR-FREEZING INDEX | | | | | |
|----------------|---|--|--|---|---|--|
| | 1500 or less | 2000 | 2500 | 3000 | 3500 | 4000 |
| Mississippi | All counties | — | — | — | — | — |
| Missouri | All counties not listed | Atchison, Mercer, Nodaway, Putnam | — | — | — | — |
| Montana | Mineral | Broadwater, Golden Valley, Granite, Lake, Lincoln, Missoula, Ravalli, Sanders, Sweet Grass | Big Horn, Carbon, Jefferson, Judith Basin, Lewis and Clark, Meagher, Musselshell, Powder River, Powell, Silver Bow, Stillwater, Westland | Carter, Cascade, Deer Lodge, Falcon, Fergus, Flathead, Gallanting, Glacier, Madison, Park, Petroleum, Ponder, Rosebud, Teton, Treasure, Yellowstone | Beaverhead, Blaine, Chouteau, Custer, Dawson, Garfield, Liberty, McCone, Prairie, Toole, Wibaux | Daniels, Hill, Phillips, Richland, Roosevelt, Sheridan, Valley |
| Nebraska | Adams, Banner, Chase, Cheyenne, Clay, Deuel, Dundy, Fillmore, Franklin, Frontier, Furnas, Gage, Garden, Gosper, Harlan, Hayes, Hitchcock, Jefferson, Kimball, Morrill, Nemaha, Nuckolls, Pawnee, Perkins, Phelps, Red Willow, Richardson, Saline, Scotts Bluff, Seward, Thayer, Webster | All counties not listed | Boyd, Burt, Cedar, Cuming, Dakota, Dixon, Dodge, Knox, Thurston | — | — | — |
| Nevada | All counties not listed | Elko, Eureka, Nye, Washoe, White Pine | — | — | — | — |
| New Hampshire | — | All counties not listed | — | — | — | Carroll, Coos, Grafton |
| New Jersey | All counties | — | — | — | — | — |
| New Mexico | All counties not listed | Rio Arriba | Colfax, Mora, Taos | — | — | — |
| New York | Albany, Bronx, Cayuga, Columbia, Cortland, Dutchess, Genessee, Kings, Livingston, Monroe, Nassau, New York, Niagara, Onondaga, Ontario, Orange, Orleans, Putnam, Queens, Richmond, Rockland, Seneca, Suffolk, Wayne, Westchester, Yates | All counties not listed | Clinton, Essex, Franklin, Hamilton, Herkimer, Jefferson, Lewis, St. Lawrence, Warren | — | — | — |
| North Carolina | All counties | — | — | — | — | — |

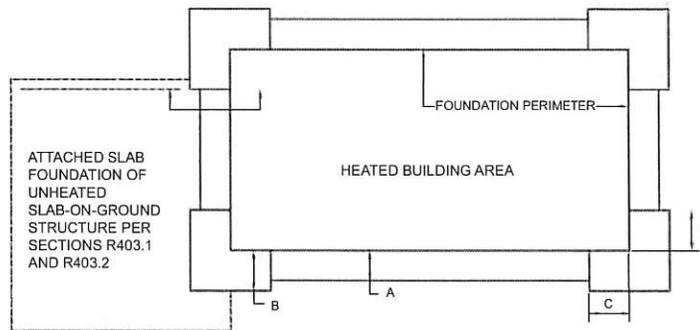
(continued)

FOUNDATIONS

INSULATION DETAIL



HORIZONTAL INSULATION PLAN



For SI: 1 inch = 25.4 mm.

a. See Table R403.3(1) for required dimensions and R-values for vertical and horizontal insulation.

FIGURE R403.3(3)
INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS ADJACENT TO UNHEATED SLAB-ON-GROUND STRUCTURE

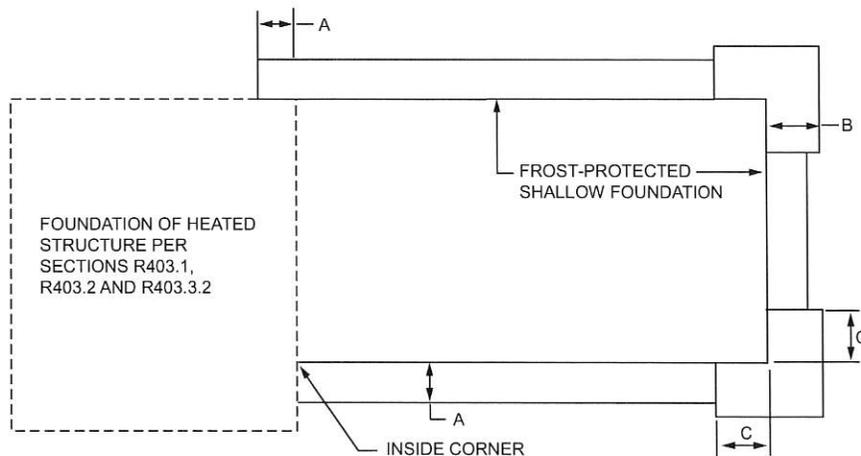


FIGURE R403.3(4)
INSULATION PLACEMENT FOR FROST-PROTECTED FOOTINGS ADJACENT TO HEATED STRUCTURE

FOUNDATIONS

TABLE R403. MINIMUM DEPTH (D) AND WIDTH (W) OF CRUSHED STONE FOOTINGS^{a, b} (inches)

| NUMBER OF STORIES | UNIFORM WALL LOAD | DEPTH (D) AND WIDTH (W) | LOAD-BEARING VALUE OF SOIL (psf) | | | | | | | | | | | | | | | | | | | | | | | |
|--|-------------------|-------------------------|----------------------------------|----|-------------------------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|---------------------|----|--|--|
| | | | 1500 | | | | 2000 | | | | 2500 | | | | 3000 | | | | 3500 | | | | 4000 | | | |
| | | | MH, CH, CL, ML ^c | | SC, GC, SM, GM, SP, SW ^c | | GP, GW ^c | | | |
| Conventional light-frame construction | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1-story | 1100 plf | D | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | |
| | | W | 13 | 15 | 17 | 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 | 4 | 4 | | | | |
| | | W | 15 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | | | |
| 3-story | 2900 plf | D | 14 | 12 | 10 | 9 | 7 | 5 | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | |
| | | W | 25 | 24 | 24 | 19 | 19 | 18 | 15 | 15 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | | |
| 4-inch brick veneer over light-frame or 8-inch hollow concrete masonry | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1-story | 1500 plf | D | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | |
| | | W | 13 | 15 | 17 | 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 | 4 | 4 | | | | |
| | | W | 22 | 23 | 23 | 18 | 17 | 17 | 14 | 15 | 17 | 13 | 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 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | |
| | | W | 33 | 34 | 33 | 25 | 26 | 25 | 20 | 20 | 21 | 17 | 17 | 17 | 14 | 15 | 17 | 13 | 15 | 17 | 13 | 15 | 17 | | | |
| 8-inch solid or fully grouted masonry | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1-story | 2000 plf | D | 7 | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | |
| | | W | 17 | 17 | 17 | 13 | 15 | 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 | 4 | 4 | | | | |
| | | W | 30 | 30 | 30 | 22 | 23 | 23 | 19 | 19 | 19 | 18 | 15 | 15 | 17 | 13 | 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 | 4 | 4 | 4 | | | |
| | | W | 43 | 44 | 44 | 33 | 32 | 33 | 27 | 27 | 26 | 22 | 22 | 22 | 19 | 20 | 19 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | | |

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.
- c. Soil classes are in accordance with the Unified Soil Classification System. Refer to Table R4045.1.

FOUNDATIONS

R403.4.1 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 $\frac{1}{2}$ inch (12.7 mm) and the minimum stone size not to be smaller than $\frac{1}{16}$ inch (1.6 mm). Crushed stone footings for precast foundations shall be installed in accordance with Figure R403.4(1) and Table R403.4. 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.

R403.4.2 Concrete footings. Concrete footings shall be installed in accordance with Section R403.1 and Figure R403.4(2).

SECTION R404 FOUNDATION AND RETAINING WALLS

R404.1 Concrete and masonry foundation walls. Concrete foundation walls shall be selected and constructed in accordance with the provisions of Section R404.1.3. Masonry foundation walls shall be selected and constructed in accordance with the provisions of Section R404.1.2.

R404.1.1 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.

R404.1.2 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. Where TMS 402 or the provisions of this section are used to design masonry foundation walls, project drawings, typical details and specifications are not required to bear the seal of the architect or engineer responsible for design, unless otherwise required by the state law of the jurisdiction having authority.

R404.1.2.1 Masonry foundation walls. Concrete masonry and clay masonry foundation walls shall be constructed as set forth in Table R404.1.1(1), R404.1.1(2), R404.1.1(3) or R404.1.1(4) and shall comply with applicable provisions of Section R606. In buildings assigned to Seismic Design Categories D_0 , D_1 and D_2 , concrete masonry and clay masonry foundation walls shall also comply with Section R404.1.4.1. Rubble stone masonry foundation walls shall be constructed in accordance with Sections R404.1.8 and R606.4.2. Rubble stone masonry walls shall not be used in Seismic Design Categories D_0 , D_1 and D_2 .

R404.1.3 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

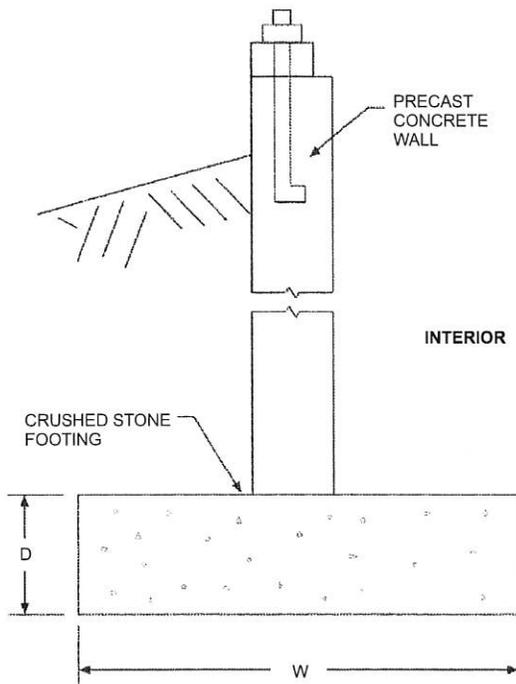


FIGURE R403.4(1)
BASEMENT OR CRAWL SPACE WITH PRECAST
FOUNDATION WALL BEARING ON CRUSHED STONE

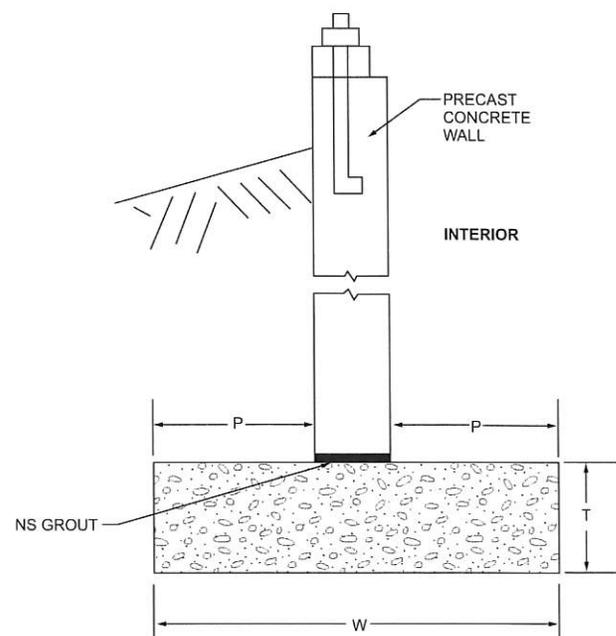


FIGURE R403.4(2)
BASEMENT OR CRAWL SPACE WITH PRECAST
FOUNDATION WALL ON SPREAD FOOTING

APPENDIX F

RADON CONTROL METHODS

About this appendix: Appendix F contains provisions that are intended to mitigate the transfer of radon gases from the soil into dwelling units. Radon is a radioactive gas that has been identified as a cancer-causing agent. Radon comes from the natural breakdown of uranium in soil, rock and water.

SECTION AF101 SCOPE

AF101.1 General. This appendix contains requirements for new construction in *jurisdictions* where radon-resistant construction is required. Inclusion of this appendix by jurisdictions shall be determined through the use of locally available data or determination of Zone 1 designation in Figure AF101 and Table AF101(1).

SECTION AF102 DEFINITIONS

AF102.1 General. For the purpose of these requirements, the terms used shall be defined as follows:

DRAIN TILE LOOP. A continuous length of drain tile or perforated pipe extending around all or part of the internal or external perimeter of a *basement* or crawl space footing.

RADON GAS. A naturally occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through particles of soil and rock, and can accumulate under the slabs and foundations of homes where it can easily enter into the living space through construction cracks and openings.

SOIL-GAS-RETARDER. A continuous membrane of 6-mil (0.15 mm) polyethylene or other equivalent material used to retard the flow of soil gases into a building.

SUBMEMBRANE DEPRESSURIZATION SYSTEM. A system designed to achieve lower submembrane air pressure relative to crawl space air pressure by use of a vent drawing air from beneath the soil-gas-retarder membrane.

SUBSLAB DEPRESSURIZATION SYSTEM (Active). A system designed to achieve lower subslab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

SUBSLAB DEPRESSURIZATION SYSTEM (Passive). A system designed to achieve lower subslab air pressure relative to indoor air pressure by use of a vent pipe routed through the *conditioned space* of a building and connecting the subslab area with outdoor air, thereby relying on the convective flow of air upward in the vent to draw air from beneath the slab.

SECTION AF103 REQUIREMENTS

AF103.1 General. The following construction techniques are intended to resist radon entry and prepare the building for post-construction radon mitigation, if necessary (see Figure AF103). These techniques are required in areas where designated by the *jurisdiction*. Alternative system designs may be installed when approved by the code official.

AF103.2 Subfloor preparation. A layer of gas-permeable material shall be placed under all concrete slabs and other floor systems that directly contact the ground and are within the walls of

the living spaces of the building, to facilitate future installation of a subslab depressurization system, if needed. The gas-permeable layer shall consist of one of the following:

1. A uniform layer of clean aggregate, not less than 4 inches (102 mm) thick. The aggregate shall consist of material that will pass through a 2-inch (51 mm) sieve and be retained by a 1/4-inch (6.4 mm) sieve.
2. A uniform layer of sand (native or fill), not less than 4 inches (102 mm) thick, overlain by a layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.
3. Other materials, systems or floor designs with demonstrated capability to permit depressurization across the entire subfloor area.

AF103.4 Entry routes. Potential radon entry routes shall be closed in accordance with Sections AF103.4.1 through AF103.4.10.

AF103.4.1 Floor openings. Openings around bathtubs, showers, water closets, pipes, wires or other objects that penetrate concrete slabs, or other floor assemblies, shall be filled with a polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.

AF103.4.2 Concrete joints. Control joints, isolation joints, construction joints, and any other joints in concrete slabs or between slabs and foundation walls shall be sealed with a caulk or sealant. Gaps and joints shall be cleared of loose material and filled with polyurethane caulk or other elastomeric sealant applied in accordance with the manufacturer's recommendations.

AF103.4.3 Condensate drains. Condensate drains shall be trapped or routed through nonperforated pipe to daylight.

AF103.4.4 Sumps. Sump pits open to soil or serving as the termination point for subslab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid. Sumps used as the suction point in a subslab depressurization system shall have a lid designed to accommodate the vent pipe. Sumps used as a floor drain shall have a lid equipped with a trapped inlet.

AF103.4.5 Foundation walls. Hollow block masonry foundation walls shall be constructed with either a continuous course of *solid masonry*, one course of masonry grouted solid, or a solid concrete beam at or above finished ground surface to prevent the passage of air from the interior of the wall into the living space. Where a brick veneer or other masonry ledge is installed, the course immediately below that ledge shall be sealed. Joints, cracks or other openings around all penetrations of both exterior and interior surfaces of masonry block or wood foundation walls below the ground surface shall be filled with polyurethane caulk or equivalent sealant. Penetrations of concrete walls shall be filled.

AF103.4.6 Dampproofing. The exterior surfaces of portions of concrete and masonry block walls below the ground surface shall be dampproofed in accordance with Section R406.

AF103.4.7 Air-handling units. Air-handling units in crawl spaces shall be sealed to prevent air from being drawn into the unit.

Exception: Units with gasketed seams or units that are otherwise sealed by the manufacturer to prevent leakage.

AF103.4.8 Ducts. Ductwork passing through or beneath a slab shall be of seamless material unless the air-handling system is designed to maintain continuous positive pressure within such ducting. Joints in such ductwork shall be sealed to prevent air leakage. Ductwork located in crawl spaces shall have seams and joints sealed by closure systems in accordance with Section M1601.4.1.

AF103.4.9 Crawl space floors. Openings around all penetrations through floors above crawl spaces shall be caulked or otherwise filled to prevent air leakage.

AF103.4.10 Crawl space access. Access doors and other openings or penetrations between *basements* and adjoining crawl spaces shall be closed, gasketed or otherwise filled to prevent air leakage.

AF103.5 Passive submembrane depressurization system. In buildings with crawl space foundations, the following components of a passive submembrane depressurization system shall be installed during construction.

Exception: Buildings in which an *approved* mechanical crawl space ventilation system or other equivalent system is installed.

AF103.5.1 Ventilation. Crawl spaces shall be provided with vents to the exterior of the building. The minimum net area of ventilation openings shall comply with Section R408.1.

AF103.5.3 Vent pipe. A plumbing tee or other *approved* connection shall be inserted horizontally beneath the sheeting and connected to a 3- or 4-inch-diameter (76 or 102 mm) fitting with a vertical vent pipe installed through the sheeting. The vent pipe shall be extended up through the building floors, and terminate not less than 12 inches (305 mm) above the roof in a location not less than 10 feet (3048 mm) away from any window or other opening into the *conditioned spaces* of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

AF103.6 Passive subslab depressurization system. In *basement* or slab-on-grade buildings, the following components of a passive subslab depressurization system shall be installed during construction.

AF103.6.1 Vent pipe. A minimum 3-inch-diameter (76 mm) ABS, PVC or equivalent gas-tight pipe shall be embedded vertically into the subslab aggregate or other permeable material before the slab is cast. A "T" fitting or equivalent method shall be used to ensure that the pipe opening remains within the subslab permeable material. Alternatively, the 3-inch (76 mm) pipe shall be inserted directly into an interior perimeter drain tile loop or through a sealed sump cover where the sump is exposed to the subslab aggregate or connected to it through a drainage system. The pipe shall be extended up through the building floors, and terminate not less than 12 inches (305 mm) above the surface of the roof in a location not less than 10 feet (3048 mm) away from any window or other opening into the *conditioned spaces* of the building that is less than 2 feet (610 mm) below the exhaust point, and 10 feet (3048 mm) from any window or other opening in adjoining or adjacent buildings.

AF103.6.2 Multiple vent pipes. In buildings where interior footings or other barriers separate the subslab aggregate or other gas-permeable material, each area shall be fitted with an individual vent pipe. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.

AF103.7 Vent pipe drainage. Components of the radon vent pipe system shall be installed to provide positive drainage to the ground beneath the slab or soil-gas-retarder.

AF103.8 Vent pipe accessibility. Radon vent pipes shall be accessible for future fan installation through an *attic* or other area outside the *habitable space*.

Exception: The radon vent pipe need not be accessible in an *attic* space where an *approved* roof-top electrical supply is provided for future use.

AF103.8.1 Vent fan location. The vent fan shall be located within three feet of an attic access opening.

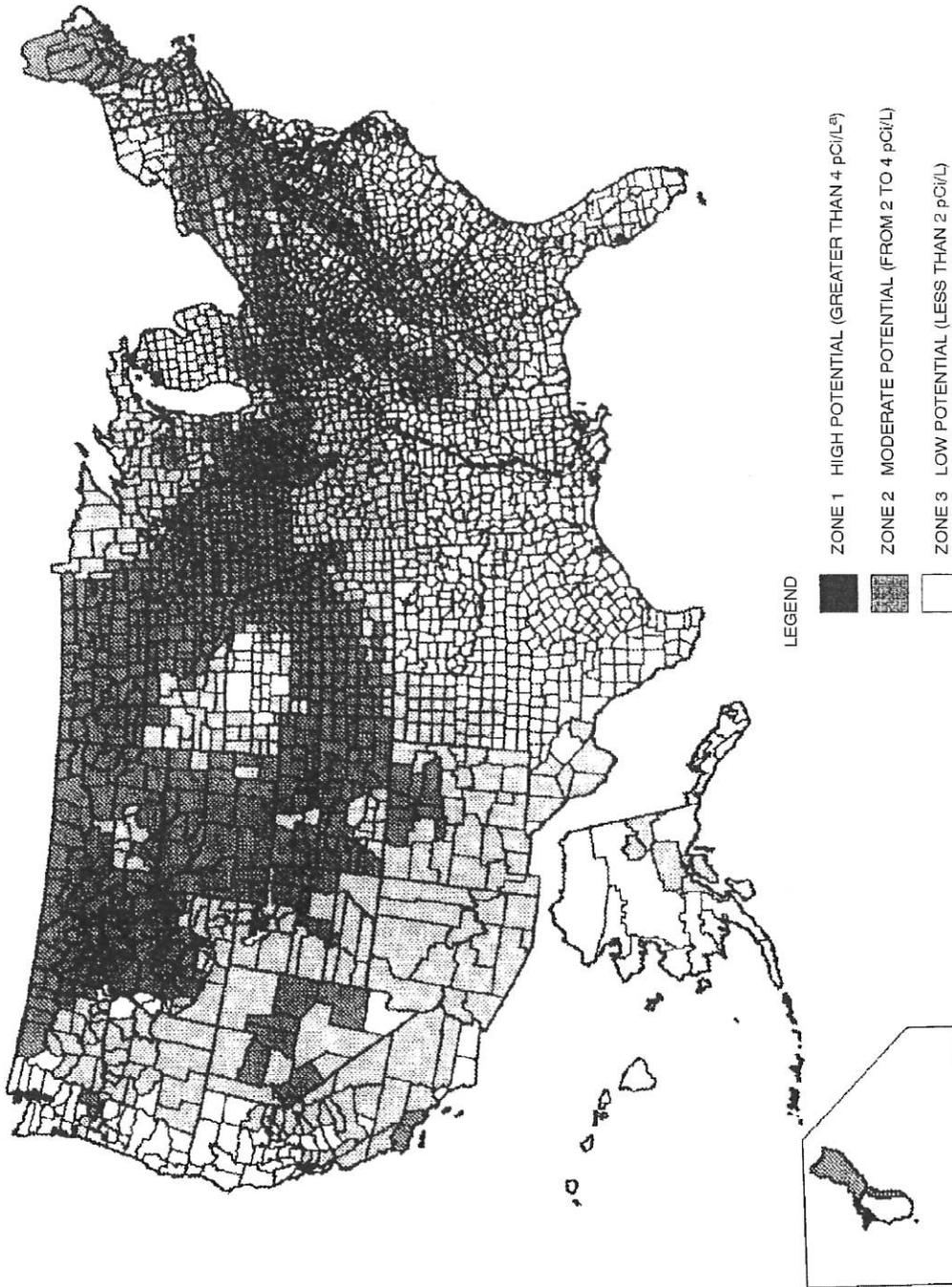
- 1) **Exception:** An elevated walkway above insulation is provided from attic access to vent piping. Walkway shall be elevated a minimum of 30" above bottom of ceiling joists and a minimum of 30" below bottom of rafters. Walkway shall be a minimum of 24" wide.
- 2) **Exception:** Attic access and radon vent are both located within the garage footprint. Radon vent shall be exposed with the garage footprint and within 6 feet of an electrical outlet.

AF103.9 Vent pipe identification. Exposed and visible interior radon vent pipes shall be identified with not less than one *label* on each floor and in accessible *attics*. The *label* shall read: "Radon Reduction System."

AF103.10 Combination foundations. Combination *basement/* crawl space or slab-on-grade/crawl space foundations shall have separate radon vent pipes installed in each type of foundation area. Each radon vent pipe shall terminate above the roof or shall be connected to a single vent that terminates above the roof.

AF103.11 Building depressurization. Joints in air ducts and plenums in *unconditioned spaces* shall meet the requirements of Section M1601. Thermal envelope air infiltration requirements shall comply with the energy conservation provisions in Chapter 11. Fireblocking shall meet the requirements contained in Section R302.11.

AF103.12 Power source. To provide for future installation of an active submembrane or subslab depressurization system, an electrical circuit terminated in an *approved* box shall be installed during construction in the *attic* or other anticipated location of vent pipe fans. An electrical supply shall be accessible in anticipated locations of system failure alarms.



LEGEND

- ZONE 1 HIGH POTENTIAL (GREATER THAN 4 pCi/L^a)
- ZONE 2 MODERATE POTENTIAL (FROM 2 TO 4 pCi/L)
- ZONE 3 LOW POTENTIAL (LESS THAN 2 pCi/L)

a. pCi/L standard for picocuries per liter of radon gas. The U.S. Environmental Protection Agency (EPA) recommends that homes that measure 4 pCi/L and greater be mitigated. The EPA and the U.S. Geological Survey have evaluated the radon potential in the United States and have developed a map of radon zones designed to assist *building officials* in deciding whether radon-resistant features are applicable in new construction. The map assigns each of the 3,141 counties in the United States to one of three zones based on radon potential. Each zone designation reflects the average short-term radon measurement that can be expected to be measured in a building without the implementation of radon-control methods. The radon zone designation of highest priority is Zone 1. Table AF101 lists the Zone 1 counties illustrated on the map. More detailed information can be obtained from state-specific booklets (EPA-402-R-93-021 through 070) available through State Radon Offices or from EPA Regional Offices.

FIGURE AF101
EPA MAP OF RADON ZONES

APPENDIX F

TABLE AF101(1)—continued
HIGH RADON-POTENTIAL (ZONE 1) COUNTIES^a

| | | | | | | |
|----------------------|--------------------|---------------------|---------------------|------------------|--------------------|----------------|
| NEBRASKA | Morris | Columbiana | Lehigh | Union | Fairfax | Crawford |
| Adams | Somerset | Coshocton | Luzerne | Walworth | Falls Church | Dane |
| Boone | Sussex | Crawford | Lycoming | Yankton | Fluvanna | Dodge |
| Boyd | Warren | Darke | Mifflin | | Frederick | Door |
| Burt | | Delaware | Monroe | TENNESSEE | Fredericksburg | Fond du Lac |
| Butler | NEW MEXICO | Fairfield | Montgomery | Anderson | Giles | Grant |
| Cass | Bernalillo | Fayette | Montour | Bedford | Goochland | Green |
| Cedar | Colfax | Franklin | Northampton | Blount | Harrisonburg | Green Lake |
| Clay | Mora | Greene | Northumberland | Bradley | Henry | Iowa |
| Colfax | Rio Arriba | Guernsey | Perry | Claiborne | Highland | Jefferson |
| Cuming | San Miguel | Hamilton | Schuylkill | Davidson | Lee | Lafayette |
| Dakota | Santa Fe | Hancock | Snyder | Giles | Lexington | Langlade |
| Dixon | Taos | Hardin | Sullivan | Grainger | Louisa | Marathon |
| Dodge | | Harrison | Susquehanna | Greene | Martinsville | Menominee |
| Douglas | NEW YORK | Holmes | Tioga | Hamblen | Montgomery | Pepin |
| Fillmore | Albany | Huron | Union | Hancock | Nottoway | Pierce |
| Franklin | Allegany | Jefferson | Venango | Hawkins | Orange | Portage |
| Frontier | Broome | Knox | Westmoreland | Hickman | Page | Richland |
| Furnas | Cattaraugus | Licking | Wyoming | Humphreys | Patrick | Rock |
| Gage | Cayuga | Logan | York | Jackson | Pittsylvania | Shawano |
| Gosper | Chautauqua | Madison | | Jefferson | Powhatan | St. Croix |
| Greeley | Chemung | Marion | RHODE ISLAND | Knox | Pulaski | Vernon |
| Hamilton | Chenango | Mercer | Kent | Lawrence | Radford | Walworth |
| Harlan | Columbia | Miami | Washington | Lewis | Roanoke | Washington |
| Hayas | Cortland | Montgomery | | Lincoln | Rockbridge | Waukesha |
| Hitchcock | Delaware | Morrow | S. CAROLINA | Loudon | Rockingham | Waupaca |
| Hurston | Dutchess | Muskingum | Greenville | Marshall | Russell | Wood |
| Jefferson | Erie | Perry | | Maury | Salem | WYOMING |
| Johnson | Genesee | Pickaway | S. DAKOTA | McMinn | Scott | Albany |
| Kearney | Greene | Pike | Aurora | Meigs | Shenandoah | Big Horn |
| Knox | Livingston | Preble | Beadle | Monroe | Smyth | Campbell |
| Lancaster | Madison | Richland | Bon Homme | Moore | Spotsylvania | Carbon |
| Madison | Onondaga | Ross | Brookings | Perry | Stafford | Converse |
| Nance | Ontario | Seneca | Brown | Roane | Staunton | Crook |
| Nemaha | Orange | Shelby | Brule | Rutherford | Tazewell | Fremont |
| Nuckolls | Otsego | Stark | Buffalo | Smith | Warren | Goshen |
| Otoe | Putnam | Summit | Campbell | Sullivan | Washington | Hot Springs |
| Pawnee | Rensselaer | Tuscarawas | Charles Mix | Trousdale | Waynesboro | Johnson |
| Phelps | Schoharie | Union | Clark | Union | Winchester | Laramie |
| Pierce | Schuylers | Van Wert | Clay | Washington | Wythe | Lincoln |
| Platte | Seneca | Warren | Codington | Wayne | | Natrona |
| Polk | Steuben | Wayne | Corson | Williamson | WASHINGTON | Niobrara |
| Red Willow | Sullivan | Wyandot | Davison | Wilson | Clark | Park |
| Richardson | Tioga | | Day | | Ferry | Sheridan |
| Saline | Tompkins | PENNSYLVANIA | Deuel | UTAH | Okanogan | Sublette |
| Sarpy | Ulster | Adams | Douglas | Carbon | Pend Oreille | Sweetwater |
| Saunders | Washington | Allegheny | Edmunds | Duchesne | Skamania | Teton |
| Seward | Wyoming | Armstrong | Faulk | Grand | Spokane | Uinta |
| Stanton | Yates | Beaver | Grant | Piute | Stevens | Washakie |
| Thayer | | Bedford | Hamlin | Sanpete | | |
| Washington | | Berks | Hand | Sevier | W. VIRGINIA | Berkeley |
| Wayne | N. CAROLINA | Blair | Hanson | Uintah | Berkeley | Brooke |
| Webster | Alleghany | Bradford | Hughes | | Grant | Greenbrier |
| York | Buncombe | Bucks | Hutchinson | VIRGINIA | Hampshire | Hancock |
| | Cherokee | Butler | Hyde | Alleghany | Hancock | Hardy |
| | Henderson | Cameron | Jerauld | Amelia | Augusta | Jefferson |
| | Mitchell | Carbon | Kingsbury | Appomattox | Bath | Marshall |
| NEVADA | Rockingham | Centre | Lake | Augusta | Bland | Mercer |
| Carson City | Transylvania | Chester | Lincoln | Bristol | Botetourt | Mineral |
| Douglas | Watauga | Clarion | Lyman | Brunswick | Bristol | Monongalia |
| Eureka | | Clearfield | Marshall | Buckingham | Brunswick | Monroe |
| Lander | | Clinton | McCook | Buena Vista | Chesterfield | Morgan |
| Lincoln | N. DAKOTA | Columbia | McPherson | Campbell | Clarke | Ohio |
| Lyon | All Counties | Cumberland | Miner | Chesterfield | Clifton Forge | Pendleton |
| Mineral | | Dauphin | Minnehaha | Clarke | Covington | Pocahontas |
| Pershing | OHIO | Delaware | Moody | Clifton Forge | Craig | Preston |
| White Pine | Adams | Franklin | Perkins | Covington | Craig | Summers |
| | Allen | Fulton | Potter | Craig | Cumberland | Wetzel |
| NEW HAMPSHIRE | Ashland | Huntingdon | Roberts | Cumberland | Danville | |
| Carroll | Auglaize | Indiana | Sanborn | Dinwiddie | Buffalo | |
| | Belmont | Juniaata | Spink | | | |
| NEW JERSEY | Butler | Lackawanna | Stanley | | | |
| Hunterdon | Carroll | Lancaster | Sully | | | |
| Mercer | Champaign | Lebanon | Turner | | | |
| Monmouth | Clark | | | | | |
| | Clinton | | | | | |

a. The EPA recommends that this county listing be supplemented with other available State and local data to further understand the radon potential of a Zone 1 area.

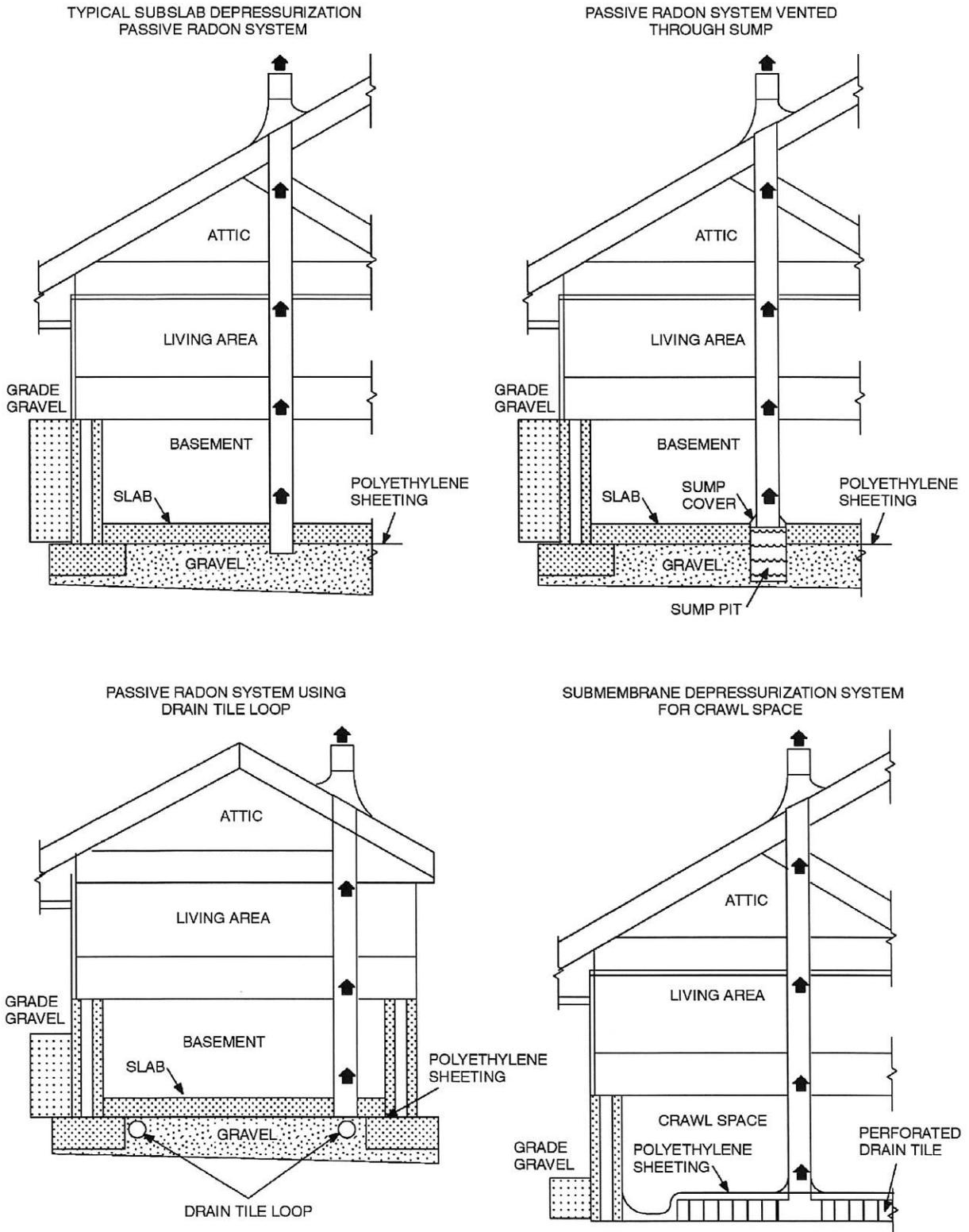


FIGURE AF103
RADON-RESISTANT CONSTRUCTION DETAILS FOR FOUR FOUNDATION TYPES