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## **RADON CONTROL METHODS**

(2008 Oregon Residential Specialty Code, Appendix F: New Homes Only, Effective April 1, 2011)

### FOUR APPROACHES:

1. Mechanical Crawl Space Ventilation System (AF103.5, exception)
  - a. See R408.2, #5, exception #3 attached for fan design criteria.
  - b. Seal all floor openings/penetrations, ductwork and air handling units.
  - c. Install gaskets on access doors.
  - d. Provide duct performance test. (See AF103.4 for b. through d.)
2. Crawl Space Passive Sub-membrane Depressurization System (AF103.5.1)
3. Crawl Space Ventilation and Building Tightness (AF103.5.2)
4. Passive Sub-slab Depressurization System (AF103.6.1)

### THE FOLLOWING NOTES APPLY TO ALL APPROACHES (except #1 above):

1. Install 4" thick river rock under slabs that will pass through a 2" sieve and be retained by a ¼" sieve. (AF103.2, #1)
2. 6 mil black plastic or equal shall be placed over rock or crawl space floor and lapped a minimum of 12" at joints. The plastic shall fit closely around all penetrations. All punctures or tears in the plastic shall be sealed or covered with additional plastic. (AF103.3)
3. Seal penetrations through slabs and other floor assemblies with a polyurethane caulk or equal. (AF103.4.1)
4. Seal all joints in concrete with an elastomeric sealant such as a polyurethane caulk. (AF103.4.2)
5. Seal open sump pits. (AF103.4.4)
6. All joints, cracks and penetrations in foundation walls shall be sealed with a polyurethane caulk or equivalent sealant. (AF103.4.5)
7. Air-handling units in crawl spaces shall be sealed (gasketed seams or sealed by the manufacturer are acceptable). (AF103.4.7)
8. All ductwork under slabs and in crawl spaces shall have all seams and joints sealed and performance tested to demonstrate conformance to ODOE duct performance standards. (AF103.4.8)
9. All penetrations in crawl space floors shall be caulked or filled. (AF103.4.9)
10. Crawl space accesses shall be gasketed to prevent air leakage. (103.4.10)
11. Install a plumbing tee beneath the 6 mil black plastic and route vertically 3" schedule 40 pipe minimum through an interior wall, not an exterior wall. (AF103.5.1.3 and Figure AF102)  
**NOTE:** Does not apply to APPROACHES #1 and #3 above.
12. When installed, vent to be 10 feet from all openings of home (windows, chimney flue, etc.). (AF103.5.1.3)
13. When installed, vent pipe shall be accessible for future fan installation through an attic or other area outside the habitable space. (AF103.8)
14. When installed, exposed vent pipe shall be labeled "Radon Reduction System" at each accessible floor and in accessible attics. (AF103.9)
15. Combination foundation types (basement/crawl or slab-on-grade/crawl) shall have separate vent pipes. (AF103.10)
16. An electrical circuit shall be installed in the attic or other anticipated location for future vent pipe fans. (AF103.12)
17. An electrical supply shall be accessible in anticipated location of system failure alarms. (AF103.12)

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

**R406.3 Dampproofing for wood foundations.** Wood foundations enclosing habitable or usable spaces located below grade shall be dampproofed in accordance with Sections R406.3.1 through R406.3.4.

**R406.3.1 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.

**R406.3.2 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 preservatively treated lumber or plywood strip attached to the wall several inches above finish 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. Other coverings appropriate to the architectural treatment may also 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.

**R406.3.3 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 back-fill 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.

**R406.3.4 Backfill.** The remainder of the excavated area shall be backfilled with the same type of soil as was removed during the excavation.

## SECTION R407 COLUMNS

**R407.1 Wood column protection.** Wood columns shall be protected against decay as set forth in Section R319.

**R407.2 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.

**R407.3 Structural requirements.** The columns shall be restrained to prevent lateral displacement at the bottom end. Wood columns shall not be less in nominal size than 4 inches by 4 inches (102 mm by 102 mm) and steel columns shall not be less than 3-inch-diameter (76 mm) standard pipe or approved equivalent.

**Exception:** Columns no more than 48 inches (1219 mm) in height on a pier or footing are exempt from the bottom end

lateral displacement requirement within underfloor areas enclosed by a continuous foundation. (see Figure R502.9)

## SECTION R408 UNDER-FLOOR SPACE

**R408.1 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 not be less than 1 square foot (0.0929 m<sup>2</sup>) for each 150 square feet (14 m<sup>2</sup>) of under-floor space area. One such ventilating opening shall be within 3 feet (914 mm) of each corner of the building.

**R408.2 Openings for under-floor ventilation.** The minimum net area of ventilation openings shall not be less than 1 square foot (0.0929 m<sup>2</sup>) for each 150 square feet (14 m<sup>2</sup>) of under-floor area. One ventilating opening shall be within 3 feet (914 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. Expanded sheet metal plates not less than 0.047 inch (1.2 mm) thick.
2. Cast-iron grill or grating.
3. Extruded load-bearing brick vents.
4. Hardware cloth of 0.035 inch (0.89 mm) wire or heavier.
5. Corrosion-resistant wire mesh, with the least dimension being 1/8 inch (3.2 mm).

### Exceptions:

1. The total area of ventilation openings may be reduced to 1/1500 of the under-floor area where the ground surface is treated with an approved ground cover material and the required openings are placed so as to provide cross-ventilation of the space. The installation of operable louvers shall not be prohibited.
2. Ventilation openings shall be permitted to be omitted on one side.
3. Ventilation openings are not required in the foundation when a continuously operated mechanical ventilation system is installed. The system shall be designed to have the capacity to exhaust a minimum of 1.0 cfm (0.5 L/s) for each 50 square feet (4.6 L/s) of underfloor area. The ground surface shall be covered with an approved ground cover material.

**R408.3 Access.** Access shall be provided to all under-floor spaces. Access openings through the floor shall be a minimum of 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). When any portion 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

**2008 Oregon Residential Specialty Code  
Amending Appendix F  
Radon Control Methods**

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Per the direction of *Senate Bill 1025*, Appendix F of the 2009 International Residential Code has been adopted and amended by the State of Oregon.

The appendix has been reproduced on the following pages as an insert for the 2008 Oregon Residential Specialty Code.

APPENDIX F  
**RADON CONTROL METHODS**

*The provisions contained in this appendix are not mandatory, except for areas specified in AF101.1*

**SECTION AF101  
SCOPE**

**AF101.1 General.** This appendix contains requirements for new construction in Baker, Clackamas, Hood River, Multnomah, Polk, Washington and Yamhill counties where radon-mitigating construction is required. Additional counties may be added as specified in Chapter 83, 2010 Oregon Laws (Senate Bill 1025), Section 2.

**Chapter 83, 2010 Oregon Laws (Senate Bill 1025) is not part of this code but is reproduced here for the reader's convenience:**

**SECTION 2.** (1) The Building Codes Structures Board and the Residential and Manufactured Structures Board shall adopt design and construction standards for mitigating radon levels in new residential buildings that are identified under the structural specialty code as Group R-2 or R-3 buildings and new public buildings. In adopting the standards, the boards shall give consideration to any standards recommended by the United States Environmental Protection Agency for radon mitigation systems in buildings.

(2) The boards shall make the design and construction standards for mitigating radon levels applicable in:

(a) Baker, Clackamas, Hood River, Multnomah, Polk, Washington and Yamhill Counties; and

(b) Any county for which the boards, after consultation with the Oregon Health Authority, consider the standards appropriate due to local radon levels.

(3) The Director of the Department of Consumer and Business Services may authorize a municipality that administers and enforces one or more building inspection programs under ORS 455.148 or 455.150 to also administer and enforce any applicable standards for mitigating radon that are adopted by the boards.

(4) The director, in consultation with the boards, may adopt rules for the implementation, administration and enforcement of this section.

**SECTION AF102  
DEFINITIONS**

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

**SUBSLAB DEPRESSURIZATION SYSTEM (Passive).** A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use

of a vent pipe route through the conditioned space of a building and connecting the sub-slab area with outdoor air, thereby relying on the convective flow of air upward in the vent to draw air from beneath the slab.

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

**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-sub-membrane air pressure relative to crawl space air pressure by use of a vent drawing air from beneath the soil-gas-retarder membrane.

**SECTION AF103  
REQUIREMENTS**

**AF103.1 General.** The following construction techniques are intended to mitigate radon entry in new construction. These techniques are required in areas where designated by AF101.1.

**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 sub-slab depressurization system, if needed. The gas-permeable layer shall consist of one of the following:

1. A uniform layer of clean aggregate, a minimum of 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 ¼-inch (6.4 mm) sieve.
2. A uniform layer of sand (native or fill), a minimum of 4 inches (102 mm) thick, overlain by a

layer or strips of geo-textile 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 sub-floor area.

**AF103.3 Soil-gas-retarder.** A minimum 6-mil (0.15 mm) [or 3-mil (0.075 mm) cross-laminated] polyethylene or equivalent flexible sheeting material shall be placed on top of the gas-permeable layer prior to casting the slab or placing the floor, assembly to serve as a soil-gas-retarder by bridging any cracks that develop in the slab or floor assembly and to prevent concrete from entering the void spaces in the aggregate base material. The sheeting shall cover the entire floor area with separate sections of sheeting lapped at least 12 inches (305 mm). The sheeting shall fit closely around any pipe, wire or other penetrations of the material. All punctures or tears in the material shall be sealed or covered with additional sheeting.

**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.** All 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 non-perforated pipe to daylight.

**AF103.4.4 Sumps.** Sump pits open to soil or serving as the termination point for sub-slab or exterior drain tile loops shall be covered with a gasketed or otherwise sealed lid. Sumps used as the suction point in a sub-slab 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 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 of this code.

**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 and shall be performance tested to demonstrate conformance to ODOE duct performance standards.

Ductwork located in crawl spaces shall have all seams and joints sealed by closure systems in accordance with Section M1601.4.1. Ductwork shall be performance tested to demonstrate conformance to ODOE duct performance standards.

**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 Crawl space mitigation system.** In buildings with crawl space foundations, a system complying with AF103.5.1 or AF103.5.2 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 Passive sub-membrane depressurization system.**

**AF103.5.1.1 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 of this code.

**AF103.5.1.2 Soil-gas-retarder.** The soil in crawl spaces shall be covered with a continuous layer of minimum 6-mil (0.15 mm) polyethylene soil-gas-retarder. The ground cover shall be lapped a minimum of 12 inches (305 mm) at joints and shall extend to all foundation walls enclosing the crawl space area.

**AF103.5.1.3 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 mm or 102 F-2 mm) fitting with a vertical vent pipe installed through the sheeting. The vent pipe shall be extended up through the building floors, terminate at least 12 inches (305 mm) above the roof in a location at least 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.

#### **AF103.5.2 Crawl space ventilation and building tightness.**

**AF03.5.2.1 Ventilation.** Crawl spaces shall be provided with vents to the exterior of the building that comply with Section R408.1 of this code. The minimum net area of ventilation openings shall not be less than 1 sq. ft. (0.0929 m<sup>2</sup>) for each 150 sq. ft. (14 m<sup>2</sup>) of underfloor space area.

**AF103.5.2.2 Ventilation openings.** Ventilation openings shall comply with Section R408.2. Operable louvers, dampers, or other means to temporarily stop the ventilation shall not be permitted.

**AF103.5.2.3 Building tightness.** Dwellings shall be tested with a blower door, depressurizing the dwelling to 50 Pascal's from ambient conditions and found to exhibit no more than 5.0 air changes per hour. A mechanical exhaust, supply, or combination ventilation system providing whole-building ventilation rates specified in Table N1101.1(3) or ASHRAE 62.2 shall be installed within the dwelling unit.

**AF103.6 Passive subslab depressurization system.** In basement or slab-on-grade buildings, the following components of a passive sub-slab 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 sub-slab 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 sub-slab 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 sub-slab aggregate or connected to it through a drainage system.

The pipe shall be extended up through the building floors, terminate at least 12 inches (305 mm) above the surface of the roof in a location at least 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 sub-slab 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.** All 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.

**AF103.9 Vent pipe identification.** All exposed and visible interior radon vent pipes shall be identified with at least 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. Firestopping shall meet the requirements contained in Section R602.8.

**AF103.12 Power source.** To provide for future installation of an active sub-membrane or sub-slab 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 also be accessible in anticipated location of system failure alarms.

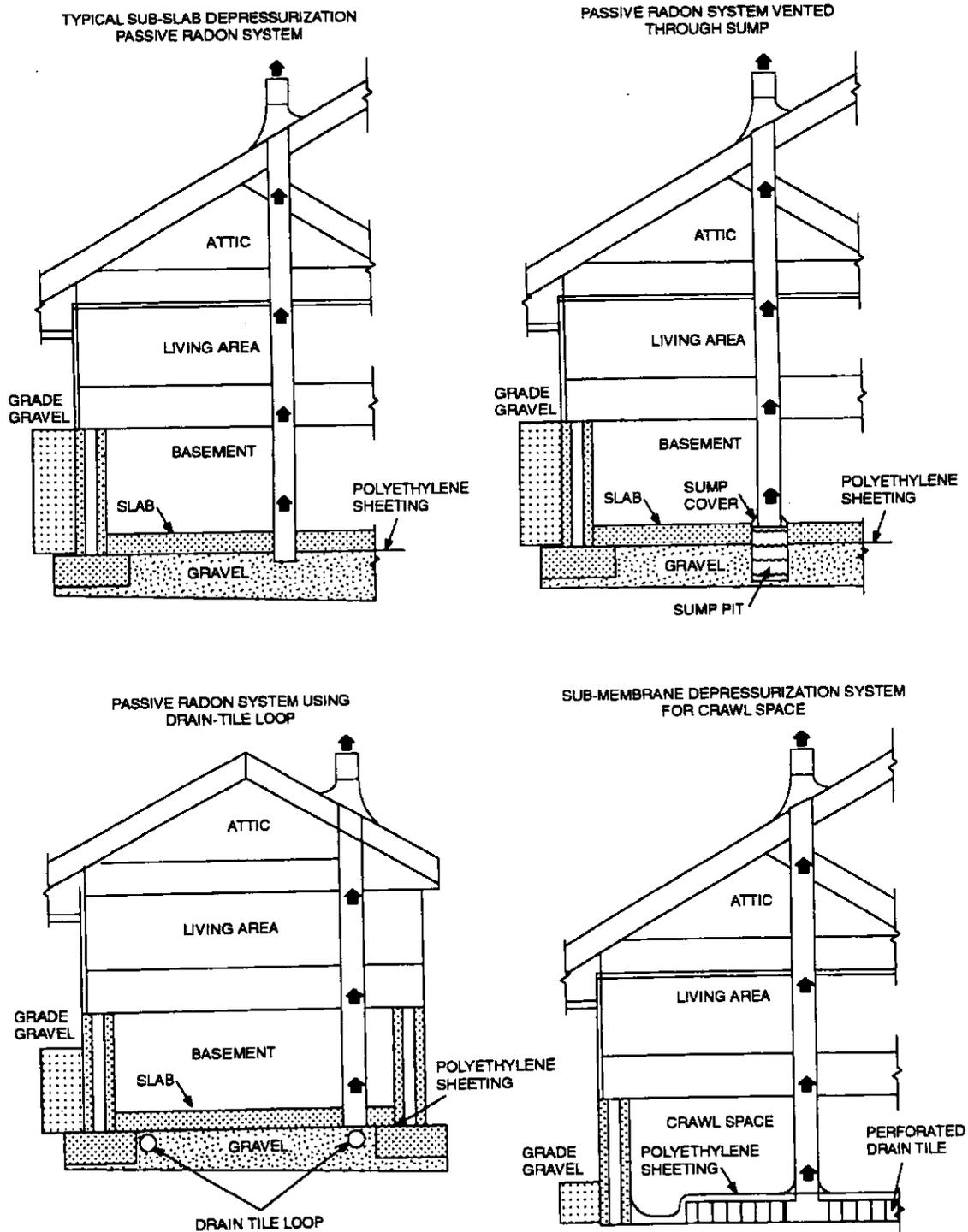


FIGURE AF102  
 RADON-RESISTANT CONSTRUCTION DETAILS FOR FOUR FOUNDATION TYPES