Santa Fe Residential Building Code
Item 902.3 Guidance

RADON CONTROL METHODS

SECTION 1

SCOPE

1.1 General. The requirement for radon-resistant was determined as Santa Fe County has a Zone 1 designation for radon risk.

SECTION 2

DEFINITIONS

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

SUB-SLAB DEPRESSURIZATION SYSTEM (Passive). A system designed to achieve lower sub-slab air pressure relative to indoor air pressure by use of a vent pipe routed 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.

SUB-SLAB 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.

GAS-PERMEABLE LAYER. Material such as a layer of clean aggregate, lengths or loops of drainage mat or perforated pipe, or other gas permeable material that is placed beneath the sealed ground cover (concrete slab or membrane) and that acts to extend the negative pressure field from the point of suction and collect soil gas.

RADON GAS. A naturally-occurring, chemically inert, radioactive gas that is not detectable by human senses. As a gas, it can move readily through small spaces within 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 and by diffusing through construction materials.

SEALED GROUND COVER : A concrete slab or membrane of 6-mil (0.15 mm) polyethylene, 3-mil (0.075 mm) cross-laminated polyethylene, or other equivalent material that is installed on top of the gas-permeable layer in soil depressurization systems and sealed at the perimeter, seams, and around penetrations to create an air-tight covering of the soil and inhibit entry of radon, moisture, and other pollutants from the soil.[[I suggest this go in a subsequent section]].

SOIL-GAS-RETARDER. A continuous membrane of 6-mil (0.15 mm) polyethylene, 3-mil (0.075 mm) cross-laminated polyethylene, or other equivalent material loosely laid on the soil and overlapped approximately 12 inches (0.3 m) to retard the flow of soil gases into a building. A soil gas retarder is not required to be sealed.

SUB-MEMBRANE 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 sealed ground cover .

SECTION 3

REQUIREMENTS

3.1 General. The following construction techniques are intended to resist radon entry and prepare the building for post-construction radon mitigation, if necessary (see Figure 1). These techniques are required.

3.2 Subfloor preparation. A gas-permeable layer 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 layer or strips of geotextile drainage matting designed to allow the lateral flow of soil gases.
3. Perforated flexible or rigid pipe.
4. Other materials, systems or floor designs with demonstrated capacity to permit depressurization across the entire sub-floor area.

3.2.1 Brick on Sand Floors. The gas-permeable layer shall be installed first followed by the soil gas retarder and then the sand and brick.

3.3 Soil-gas-retarder. A soil-gas-retarder shall be placed on top of the gas-permeable layer prior to casting the slab or placing the floor assembly to bridge 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 visible punctures or tears in the materials shall be sealed or covered with additional sheeting.

3.4 Entry routes. Potential radon entry routes shall be closed in accordance with Sections 3.4.1 through 3.4.10.

3.4.1 Floor openings. Blockouts for bathtubs, showers, water closets, etc. shall be sealed with grout, expanding foam, or other equivalent removable sealant. Openings around pipes, conduit, wires or other objects that penetrate concrete slabs or other floor assemblies shall be filled with polyurethane caulk or equivalent sealant applied in accordance with the manufacturer's recommendations.

3.4.2 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 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.

3.4.3 Condensate drains. Condensate drains that drain to ground shall be trapped or routed through non-perforated pipe to daylight.

3.4.4 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.

3.4.5 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 foundations walls below the ground surface shall be filled with polyurethane caulk or equivalent sealant. Penetrations of concrete walls shall be filled.

3.4.6 Damp-proofing. The exterior surfaces of portions of concrete and masonry block walls below the ground surface shall be damp-proofed in accordance with Section R406 of the 2009 International Residential Code (IRC).

3.4.7 Air-handling units. Air-handling units in crawl spaces shall be sealed to prevent air from being drawn into the unit with mastic or foil tape, as allowed by manufacturer. Duct tape is not permitted.

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

3.4.8 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 with mastic or foil tape, as allowed by the manufacturer to prevent air leakage. Duct tape is not permitted.

Ductwork located in crawl spaces shall have all seams and joints sealed by closure systems in accordance with Section M1601.4.1 of the 2009 IRC.

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

3.4.10 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.

3.5 Passive sub-membrane depressurization system. In buildings with crawl space foundations without concrete slab floors, the following components of a passive sub-membrane depressurization system shall be installed during construction.

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

3.5.1 Ventilation. Unless a sealed membrane is installed between the ground and the first floor, crawl spaces shall be provided with, 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 the 2009 IRC.

3.5.2 Sealed membrane. The soil in crawl spaces shall be graded, smoothed and cleared of debris that could damage a membrane; have a gas-permeable layer installed; and be covered with a continuous sealed membrane . The membrane shall extend a minimum of 12 inches (305 mm) up all foundation walls enclosing the crawl space area and be sealed to the foundation walls, as well as all openings and penetrations such as columns, posts and pipes.

The membrane shall be labeled just inside the crawl access and other access locations indicating that it is part of a radon reduction system and should not be damaged.

3.5.3 Vent pipe. All vent pipe shall be Schedule 40 ABS, PVC, or equivalent. A plumbing tee or other *approved* connection shall be inserted horizontally beneath the membrane and connected to a 3- or 4-inch-diameter (76 mm or 102 mm) vertical bent pipe installed through and sealed to the membrane. 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) away from any window or other opening in adjoining or adjacent buildings.

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

3.6.1 Vent pipe. A minimum 3-inch diameter (76 mm) Schedule 40 ABS, PVC or equivalent gas-tight pipe shall be embedded vertically into the gas-permeable layer 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. Alternately, 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.

3.6.2 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 or connected together with sleeves passing through the barrier. Vent pipes shall connect to a single vent that terminates above the roof or each individual vent pipe shall terminate separately above the roof.

3.7 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.

3.8 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.

3.9 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."

3.10 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 vent that terminates above the roof.

3.11 Building depressurization. Joints in air ducts and plenums in un*conditioned spaces* shall meet the requirements of Section M1601 of the 2009 IRC. Thermal envelope air infiltration requirements shall comply with

energy conservation provisions in Chapter 11 of the 2009 IRC. Fire-stopping shall meet the requirements contained in Section R602.8 of the 2009 IRC.

3.12 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 or duplex outlet shall be installed during construction in the *attic* or other anticipated location of vent pipe fans and labeled that it is part of the radon reduction system.

Some Additional Requirements

- Additional labeling that a radon control system is installed in the house -- say in the mechanical room.

- Documentation be prepared for the owner/buyer that describes that the radon system, necessary maintenance, and recommended testing in the future, etc.

- We could allow exceptions as approved by a certified radon mitigation installer

FOLLOW-UP RADON TESTING

It is recommended that the building be tested for radon soon after occupancy to determine whether a radon fan and system monitor should be installed. Testing should be performed by an independent, certified, radon measurement professional following U.S. EPA or state protocols using both short-term and long-term measurement devices. It is also recommended that radon levels be tested again every two years, or after changes in occupants, or after major changes in the building or its substructure.