

Florida Standard
For
Mitigation of Radon
In
Existing Buildings

Effective: June 1, 1994

Introduction

Radon is a radioactive gas which occurs naturally in soils. It has been found in high concentrations in some areas of many states including Florida. Radon can enter buildings through floor cracks and openings driven by pressure differences which result from space conditioning and ventilation systems, temperatures and wind. Its radioactive decay products can cause lung cancer when breathed.

The following building standards have been developed in accordance with Section 553.98, Florida Statutes to protect the public by setting standards for mitigation of radon concentrations in existing buildings.

Principal Approaches for Radon Mitigation in Existing Buildings

This building standard addresses five principal approaches to mitigating radon accumulation in buildings:

1. Radon control using the building structure as a gas barrier. This is a passive approach which requires no fans. (See Chapter 4)
2. Radon control by lowering the air pressure in the soil beneath the building relative to the indoor air pressure of the building. This is an active approach which requires one or more electrically driven fans. (See Chapter 6)
3. Radon control by raising the indoor air pressure in the building relative to the air pressure in the soil beneath the building. This is an active approach which may either use an existing heating and air-conditioning system blower or an additional electrically driven fan. This approach may have significant negative impact on the annual energy consumption of the building due to heating and cooling of additional outdoor air in addition to fan power consumption. (See Chapter 5)
4. Radon control by ventilating the building with outdoor air. This is an active approach which may either use an existing heating and air-conditioning system blower or an additional electrically driven fan. This approach may have significant negative impact on the annual energy consumption of the building due to heating and cooling of additional outdoor air and to increased fan power consumption. (See Chapter 5)
5. Radon control by separating the building and source with a ventilated region of outside air. This approach is generally applicable to buildings with a crawl space, and may be either active or passive. (See Chapter 6)

The standard does not mandate the implementation of any of the principal approaches listed above. It establishes minimum standard practices for each of the principal approaches. Implementation of these minimum standard practices does not guarantee successful mitigation. A post mitigation indoor radon concentration test must be conducted to demonstrate successful mitigation in compliance with the rules of the Department of Health and Chapter 3 of this standard.

FOREWORD

The practices incorporated in the standard are based on experience, testing and in certain cases expectations founded on interpretation of fundamental physical principles. The demonstration of successful mitigation utilizing the different approaches incorporated in this standard varies.

Sub-slab depressurization, crawlspace ventilation, and sub-membrane depressurization have the highest demonstrated success rates. Success with these approaches has in many cases required modification and enhancement of systems based on post mitigation indoor radon tests.

Effective sealing of accessible entry points has been demonstrated to make a significant impact on indoor radon concentrations. However, mitigation by sealing entry points alone has not had a demonstrated level of success equivalent to the aforementioned active mitigation systems. This is understood to be principally because of the difficulty in locating and treating enough entry points to resist the driving forces which cause radon laden soil gas and crawlspace air entry. The significance of entry points and their treatment can be ranked based on their size, location and the degree of depressurization of the building space surrounding them. Design and construction of successful sub-slab depressurization systems also depends on entry point size, location and the magnitude of coincident building depressurization. Attention to limiting entry at points of high depressurization such as space conditioning system return plenums, mechanical closets, etc., is critical to the success of both passive mitigation and minimally designed active mitigation systems.

Building pressurization is expected, based on fundamental principles, to provide a potentially effective mitigation strategy. The effectiveness for individual cases may rely on occupant behavior as well as building leakage characteristics. Pressurization systems also have potentially major impacts on occupant comfort, humidity control and energy use.

Building ventilation has potential application where low indoor radon concentrations exist initially. This approach can have significant impacts on the ability of a building's climate control systems to perform adequately in the hot and humid climate and on energy consumption for comfort conditioning.

None of the techniques in this standard are guaranteed to provide adequate mitigation. The complexities of existing buildings and the inherent limitations in the ability to determine the building's construction characteristics result in conditions too diverse for a standard to anticipate. Successful mitigation depends on the experience of the mitigator to make an effective selection of mitigation options. A post mitigation indoor radon test is essential for determining if initial mitigation has been successful. Proper maintenance and operation of mechanical systems implemented as part of active mitigation approaches are critical to the long term effectiveness of mitigation where such systems are used. Periodic retests of indoor radon concentrations at least every two years, and when the building undergoes significant structural alterations, are advised for all mitigation approaches to provide continued assurance of safe indoor radon levels.

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CHAPTER 1

ADMINISTRATION

101 GENERAL

101.1 Title

Provisions in the following chapters and sections shall constitute and be known as, and may be cited as, the Florida Standard For Mitigation of Radon in Existing Buildings, hereinafter referred to as "this standard."

101.2 Intent

101.2.1 General This standard applies to those alterations to existing buildings that are implemented to reduce indoor radon concentrations, in order to enable control of human exposure to indoor radon and its progeny.

101.2.2 Limits This standard is intended to improve indoor air quality with respect to radon. These standards are based on the principle of limiting radon concentrations to levels as low as reasonably achievable, within the limitations at current technology and economic feasibility. Use of this standard does not guarantee radon will be limited to any specific concentrations in a building; however, experience indicates a reduction in radon and its progeny can be realized by using the mitigation strategies described in this standard.

101.2.3 Durability Experience with the radon-resistant construction details contained herein has been limited to a fraction of the average life of a building. Implementation of radon mitigation measures described herein does not guarantee that mitigation effects will be permanent. Periodic inspection and maintenance of the radon mitigation measures and retesting of indoor radon levels is the responsibility of the building owner.

101.3 Scope

101.3.1 Applicability The provisions of this standard shall apply to the construction or alteration associated with the mitigation of indoor radon in every building or structure not specifically exempted. Exempted occupancies shall include structures not intended for human occupancy.

102 ALTERNATE MATERIALS AND METHODS

The provisions of this standard are not intended to prevent the use of any material or method of construction not specifically prescribed by this standard, provided any such alternate is demonstrated according to the provisions of Chapter 3 of this standard, to be effective at the control of radon.

103 COMPLIANCE

All mitigation shall be deemed to be in compliance with this standard when:

- (a) the techniques utilized in mitigation meet the minimum standard practices established herein; and
- (b) the building is determined to meet the "not to exceed" exposure standard established by the Department of Health (DOH) or the level specified in any warranty or guarantee provided to the client. The Department of Health (DOH) has set an exposure standard for radon decay products in buildings at an annual average of 0.02 Working Levels. Under conditions often encountered in homes, this is equivalent to an annual average radon level of 4.0 picoCuries per liter. Radon levels in most buildings can be reduced to 4.0 picoCuries per liter or below.

Testing must be conducted in accordance with all applicable sections of the DOH Florida Administrative Code Chapter 64E-5 and in accordance with Chapter 3 of this standard.

CHAPTER 2

DEFINITIONS

201 GENERAL

For the purposes of this standard, certain abbreviations, terms, phrases, words and their derivatives shall be set forth in this chapter. Where terms are not defined therein, they shall have the meaning as noted in the applicable locally adopted code. Words not defined in any locally adopted code shall have the meanings in Webster's Ninth New Collegiate Dictionary, as revised.

202 DEFINITIONS

AUTOMATIC - self-acting, operating by its own mechanism when activated by some personal influence, as for example, a change in current, pressure, temperature or mechanical configuration.

CAULKS AND SEALANTS - those materials which will significantly reduce the flow of gases through small openings in the building shell. Among those used are:

Urethane - a crystalline ester-amide used as a gelatinizing agent for cellulose acetate or cellulose nitrate. A component of polyurethane used in making flexible and rigid foams, elastomers, and resins for coatings and adhesives.

CONDITIONED SPACE - all spaces which are provided with heated and/or cooled air or which are maintained at temperatures over 50°F during the heating season, including adjacent connected spaces separated by an uninsulated component (e.g. basements, utility rooms, garages, corridors).

CONTRACTOR - a building trades professional licensed by the state, including certified mitigation business.

CRAWLSPACE - an area beneath the living space in some houses, where the floor of the lowest living area is elevated above grade level. This space (which generally provides only enough head room for a person to crawl in), is not living space, but often contains utilities.

DEPRESSURIZATION - a condition that exists when the measured air pressure is lower than the reference air pressure.

ELASTOMERIC - that property of macromolecular material of returning rapidly to approximately the initial dimensions and shape, after substantial deformation by a weak stress and release of stress.

Mil - 1mil=1/1000 of an inch

MITIGATION - The act of making less severe, reducing or relieving. For the purposes of this standard, a building shall not be considered as mitigated until it has been demonstrated to meet

the standards of compliance specified in Section 103.

OUTSIDE AIR - air taken from the outdoors and, therefore, not previously circulated through the system.

PICOCURIE (pCi) - a unit of measurement of radioactivity. A curie is the amount of any radionuclide that undergoes exactly 3.7×10^{10} radioactive disintegrations per second. A picocurie is one trillionth (10^{-12}) of a curie, or 0.037 disintegrations per second.

PICOCURIE PER LITER (pCi/l) - a common unit of measurement of the concentration of radioactivity in a gas. A picocurie per liter corresponds to 0.037 radioactive disintegrations per second in every liter of air.

RADIUM (Ra) - a naturally occurring radioactive element resulting from the decay of uranium. It is the parent of radon.

RADON (Rn) - a naturally occurring, chemically inert, radioactive gas. It is part of the uranium-238 decay series, it is the direct decay product of radium-226.

SOIL DEPRESSURIZATION SYSTEM - a system designed to withdraw air below the slab through means of a vent pipe and fan arrangement (active).

SOIL GAS - gas which is always present underground, in the small spaces between particles of the soil or in crevices in rock. Major constituents of soil gas include nitrogen, water vapor, carbon dioxide, and (near the surface) oxygen. Since radium-226 is essentially always present in the soil or rock, varying levels of radon-222 will exist in the soil gas.

SOIL GAS RETARDER - a concrete slab; polyvinylchloride (PVC) ethylenepropylene diene terpolymer (EPDM), neoprene or other flexible sheet material; or other system of materials placed between the soil and the building for the purpose of reducing the flow of soil gas into the building.

VENTILATION - the process of supplying or removing air, by natural or mechanical means, to or from any space. Such air may or may not have been conditioned.

CHAPTER 3

TESTING

301 GENERAL

Where mitigation projects are performed by commercial mitigation contractors, all tests performed to demonstrate compliance with this standard must be performed by a certified radon measurement business certified by the Florida Department of Health and Rehabilitative Services. Compliance tests must be performed by a measurement business independent of the mitigation contractor.

301.1 Test Procedures Testing shall be conducted according to the procedures in the appropriate sections of EPA 402-R-92-004, "Indoor Radon and Radon Decay Product Measurement Device Protocols" (US EPA, July, 1992) and EPA 402-R-92-003, "Protocols for Radon and Radon Decay Product Measurements in Homes" (USEPA, June 1993).

301.2 Acceptable Devices and Test Periods Selection of devices, operational devices, and test periods shall be in accordance with EPA 402-R-92-004.

301.2.1 Acceptance Criteria The building will be deemed to comply with the standard if post mitigation test results performed in accordance with this chapter and all applicable sections of Chapter 64E-5, Florida Administrative Code, Part XII, Subpart A, meet the "not to exceed" exposure standard established by the Department of Health (DOH) or the level specified in any warranty or guarantee to the client.

CHAPTER 4

STRUCTURAL SEALING AND HVAC SYSTEM BALANCING

401 GENERAL

When accessible cracks, penetrations, and joints in floors and walls in contact with the soil, or separating conditioned space from a crawl space, are sealed to reduce radon entry, they shall as a minimum be sealed in accordance with the provisions of this Chapter. In addition, when acceptable indoor radon concentrations are attained by the sealing of ducts and plenums, they shall be done in accordance with the provisions of this Chapter.

402 SEALING CRACKS AND JOINTS IN CONCRETE FLOORS AND WALLS

402.1 Small Cracks and Joints Cracks and joints with widths less than 1/16 inch (0.0625") shall be repaired by the application of an elastomeric material capable of withstanding at least 25 percent extension and extending at least 4 inches beyond the length and width of the crack, or by the method described in Paragraph 402.2.

402.2 Large cracks and Joints Cracks with widths larger than 1/16 inch (0.0625") shall be enlarged to a recess with minimum dimensions of ¼ inch by ¼ inch (0.25" x 0.25") and sealed with an approved caulk or sealant applied over a sealant backer in accordance with the manufacturer's recommendations. Cracks and joints with widths less than 1/16" may also be sealed in this manner if traffic, floor covering material or other conditions are inconsistent with the provisions of Paragraph 402.1.

402.3 Utility Penetrations, Work Spaces and Large Slab Openings Where large openings through the slab exist, such as at a bath tub drain or a toilet flange, an acceptable method for sealing the exposed soil shall include fully covering the exposed soil with a solvent based plastic roof cement or other approved material as per paragraph 405.1 to a minimum depth of 1 inch. Where voids between masonry foundation walls and the slab edge are accessible, and are sealed in order to reduce radon entry, non-shrinking cementitious material may be used.

402.4 Utility Penetrations in Crawlspace Walls Utility penetrations or other openings through hollow cavity walls that separate conditioned space from soil, or conditioned space from a crawl space, shall be sealed with an approved material on both the interior and exterior faces of the wall. Penetrations and openings through solid concrete floors or walls may be sealed on only the interior face.

402.5 Hollow Masonry Walls All openings for electrical boxes or plumbing or other wall penetrations in hollow masonry walls, that are sealed in order to reduce radon entry, shall be sealed with an approved caulk and/or gasket on the interior face of the wall.

402.6 Sumps Any sump located in a conditioned portion of a building, or in an enclosed space directly attached to a conditioned portion of a building, shall be covered by a lid. An air tight seal shall be formed between the sump and lid and at any wire or pipe penetrations.

403 FLOORS OVER CRAWLSPACE

403.1 Reinforced Concrete Floors Cracks and penetrations through concrete floors constructed over crawlspaces, and that are sealed in order to reduce radon entry, shall be sealed in conformance with all applicable provisions of Section 402.

403.2 Wood Framed Floors All penetrations through the subfloor, including but not limited to plumbing pipes, wiring and ductwork, that are sealed in order to reduce radon entry, shall be sealed with an approved caulk in accordance with the manufacturer's recommendations. Where large openings are created by plumbing, such as at bath tub drains, sheet metal or other rigid and durable materials shall be used in conjunction with sealants to close and seal the opening.

404 COMBINED CONSTRUCTION TYPES

404.1 Structural Chases Openings which connect a crawlspace and the space between floor or ceiling joists, wall studs, or any other hollow chase adjoining conditioned space, that are sealed in order to reduce radon entry concentrations, shall be closed and sealed in accordance with the appropriate portions of this chapter.

404.2 Wall Penetrations Openings for electrical or plumbing connections in a wall between a crawlspace and a conditioned space, that are sealed in order to reduce radon entry, shall be closed and sealed with an approved caulk and/or gasket.

404.3 Doors When a door is located in a wall between a crawlspace and the conditioned space, it shall be fully weatherstripped or gasketed.

405 APPROVED SEALANT MATERIALS

405.1 Sealants Acceptable caulks and sealants shall conform with ASTM C920-87 "Standard Specifications for Elastomeric Joint Sealants" and ASTM C962-86 "Standard Guide for Use of Elastomeric Joint sealants". All sealant materials and methods of application shall be compatible with the location, function and material of the surface or surfaces being sealed.

406 SPACE CONDITIONING AND VENTILATION SYSTEMS

406.1 Mechanical System Connections

Condensate drains and pipe chases for freon lines that provide a direct connection between the indoor air and the soil shall be sealed in accordance with the provisions of this section.

406.1.1 Condensate Drains Condensate drains shall connect to air outside the building perimeter at a height of at least 6 inches above the finished grade ground level. Chases through which the condensate and refrigerant lines run shall not terminate in the air return plenum or duct. If a portion of the condensate pipe does not drop below the height of the condensate outlet, then a trap should be installed to prevent suction of outdoor air into the air handler.

406.1.2 Freon Chases Freon chases that terminate within the house or garage shall be sealed

with closed cell expanding foam material. Pipe insulation shall be removed from the freon lines at the point of the seal to provide for complete bond between the freon line and the foam.

406.2 Air Distribution Systems

406.2.1 Sealing All ducts and plenums that are modified or sealed in order to achieve acceptable indoor radon concentrations, shall be made airtight in accordance with the "Florida Energy Efficiency Code for Building Construction" 1993. If ductboard is used, the seal must be on the foil side of the ductboard. Mastic sealing systems designed specifically for the conditions of use shall be used in accordance with the manufacturer's recommendations to close and seal leaks in ducts or plenums. Modifications to ducts located in crawlspaces or service areas of attics shall incorporate support, cover or other protection from accidental damage.

406.2.2 Return Plenums If acceptable indoor radon concentrations are achieved in part by construction or modification of a return plenum, it shall be constructed with materials and closures which produce a continuous air barrier for the life of the building. Construction of the return plenum shall be done such that a continuous air barrier completely separates the plenum from adjacent building structures. If duct board is the primary air barrier, then the joints shall be sealed by fabric and mastic on the foil side of the board.

CHAPTER 5

ENGINEERED SYSTEMS

501 GENERAL

Design of radon mitigation systems must be signed by a certified Radon Mitigation specialist. Additionally, for radon mitigation systems that rely upon ventilation or pressurization of the conditioned space for radon control, the plans and specifications for the ventilation or pressurization system shall be signed and where appropriate sealed according to the provisions of Section 471.003, Florida Statutes and Section 553.79, Florida Statutes. Such systems may include, but are not limited to, one of the following:

501.1 Air Pressure Control Indoor pressure may be elevated relative to sub-slab levels.

501.2 Ventilation An indoor air exchange rate may be maintained in a sufficient quantity to satisfy Paragraph 502.1.

502 DESIGN CRITERIA

502.1 Compliance Any engineered radon mitigation system in compliance with this standard must maintain an indoor radon concentration equal to or less than the "not to exceed" radon exposure standard established by the Florida Department of Health during the primary hours of occupancy. The interior surfaces of buildings pressurized as the primary means of radon control, must be sealed to Infiltration Practice 3 criterion of the Florida Energy Efficiency Code for Building Construction, 1993. The design values for total ventilation and air exchange rates for each space occupancy shall not exceed the minimums provided for each space occupancy classification by ASHRAE Standard 62-1989. Where those air quantities are not sufficient to maintain indoor concentrations below the acceptable level, other mitigation options shall be used.

502.1.2 Tests The indoor radon concentration must be measured in accordance with chapter 3 and certified as acceptable according to current Florida Department of Health's rules.

502.3 System Monitoring Device Any engineered system must have a mechanism installed to automatically indicate failure of the system to building occupants, which shall be either a visual device conveniently visible to building occupants, or a device that produces a minimum 60 db audible signal.

CHAPTER 6

SOIL DEPRESSURIZATION SYSTEMS

601 GENERAL

This Chapter provides minimum design and construction criteria for active soil depressurization systems. The operating soil depressurization system shall maintain under the building a pressure less than the indoor air pressure. Systems for buildings with slab on grade floors shall as a minimum comply with Section 603.1. Systems for buildings with off grade floors shall as a minimum comply with Section 603.2 or Section 604.

602 SOIL DEPRESSURIZATION SYSTEM INSTALLATION CRITERIA

602.1 Suction Fans

602.1.1 Fan Suction shall be provided by a fan, rated for continuous operation and having thermal overload with automatic reset features.

602.1.2 Seal The suction fan shall be designed and manufactured to provide an air-tight seal between the inlet and outlet ducts and the fan housing. The fan housing must remain air-tight at air pressure equal to the rated maximum operating pressure.

602.1.3 Rating The rating specific to system type shall apply (see Sections 603.1 and 603.2).

602.1.4 Location The suction fan shall be located where any leakage of air from the exhaust portion of the fan or vent system shall be into outside air. No pressurized portion of the vent system shall pass through conditioned space.

602.1.5 Power Supply Electrical power shall be supplied to the fan in compliance with the provisions of the National Electric Code and any additional local regulations.

602.2 System Monitoring Device The soil depressurization system shall include a system monitoring device which shall be either a visual device, conveniently visible to building occupants, or a device that produces a minimum 60 db audible signal, activated by the loss of pressure or flow in the vent pipe.

602.3 Vents

602.3.1 Material Piping material shall be of any type approved by locally adopted codes for plumbing vents.

602.3.2 Slope The vent piping shall have a minimum slope of 1/8 inch per foot in order to drain any condensation back to soil beneath the soil gas retarder. The system shall be designed and installed so that no portion will allow the excess accumulation of condensation.

602.3.3 Terminals Vent pipes shall be terminated in locations that will minimize human

exposure to their exhaust air. Locations shall be above the eave of the roof. To prevent reentrainment of radon, the point of discharge from vents of fan-powered soil depressurization shall meet all of the following requirements: (1) be ten feet or more above ground level, (2) be ten feet or more from any window, door, or other opening (e.g., operable skylight, or air intake) into conditioned spaces of the structure, and (3) be ten feet or more from any opening into an adjacent building. The total required distance (ten feet) from the point of discharge to openings in the structure shall be measured either directly between the two points or be the sum of measurements made around intervening obstacles. If the point of discharge is at or below any window, door, or other opening into conditioned spaces of the structure the total required distance (ten feet) shall be measured horizontally between the two points.

602.3.4 Labeling All exposed components of the soil depressurization system shall be labeled "Soil Gas System" to prevent accidental damage or misuse. Labels shall be on a yellow band, two inches wide and spaced three feet apart on all components.

602.3.5 Clearance All vent piping shall be located in compliance with existing and applicable codes, with regards to clearances from mechanical equipment and flues and notching of structural members. No vent shall penetrate a fire wall or party wall.

603 SOIL DEPRESSURIZATION SYSTEM DESIGN CRITERIA

603.1 Sub-Slab Depressurization Systems Depressurization systems in sands or other granular soils shall as a minimum and within the practical limits posed by the building, meet the following requirements:

603.1.1 Arrangement Within the practical limits posed by the building, suction points shall be distributed as nearly equally as possible, and as follows:

- (1) A maximum of 1300 square feet per suction point, and
- (2) Each required suction point shall be located not less than 6 feet nor more than 18 feet from the perimeter; and
- (3) Multiple suction points shall be located within 36 feet of each other.

603.1.2 Pipe Size Suction pipe should be of a size appropriate to the air-flows of the system, a minimum of 1.5 inches in diameter at the fan, and shall not be reduced between the fan outlet and the final termination point.

603.1.3 Pits Suction point pits excavated below the slab shall be sized to provide adequate pressure distribution beneath the slab. Dimensions of 22 inches in diameter and 11 inches deep, or excavation of 1 cft. of soil, shall be presumed to meet this requirement. Further the pit shall be filled with 1" size gravel.

603.1.4 Rating Suction fans must be capable of developing minimum flows appropriate to the system at 1 inch water column pressure. Fans producing 100 CFM at 1 inch water column pressure are presumed to meet this requirement.

603.2 Sub-Membrane Depressurization Systems

603.2.1 General Sub-membrane soil depressurization systems are essentially the same as sub-slab depressurization systems, but without the cover of a concrete slab. The membrane shall be protected from wind uplift in accordance with locally adopted codes. Systems may be of suction pit or continuous ventilation mat design.

603.2.2 Membrane Soil-Gas Retarder A Membrane Soil-Gas Retarder shall consist of a 8 mil or thicker single ply polyethylene sheet or other sheeting material of equal or lower permeability and equal or greater strength. Place sheeting to minimize seams and to cover all of the soil below the building floor. Retarders must provide excellent environmental stress crack resistance, impact strength and high tensile strength including additives to retard polymer oxidation and UV degradation. Where pipes, columns or other objects penetrate the soil-gas retarder, it shall be cut and sealed to the pipe, column or penetration. All seams of the membrane shall be lapped at least 12 inches. Punctures or tears in the membrane shall be repaired with the same or compatible material.

603.2.3 Depressurization Systems in Sands or Granular Soils With Suction Pit Design Sub-membrane soil depressurization systems covering sand or other granular soils shall meet the requirements of section 602.1, with the suction pits filled with 1" size gravel which shall be covered by 1/8" thick steel plate, 16 gauge corrugated sheet metal, or equivalent sheets of other termite resistant structural materials, in compliance with existing and applicable codes.

603.2.4 Depressurization Systems in Sands or Granular Soils with Continuous Ventilation Mat(s) Design Depressurization systems in sands or other granular soils and utilizing a continuous ventilation mat shall have at least 216 square inches of suction area per lineal foot and shall meet the following requirements:

603.2.4.1 Arrangement Suction points shall be equally distributed as follows:

- (1) The suction point should be centrally located along the length of each unconnected strip of mat; and
- (2) Mat strips should be oriented along the central axis of the longest dimension of the crawlspace; and
- (3) A minimum of one strip shall be used for crawlspaces having widths up to 50 feet (Additional strips should be added for each additional crawlspace width of up to 50 feet width.); and
- (4) The mat strip shall extend to not closer than 6 feet of the inner stemwall at both ends of the building; and
- (5) A separate suction point and fan shall be installed for each 100 feet linear length of ventilation mat.

603.2.4.2 Pipe Size Suction pipe shall be a minimum 3 inch diameter and shall be carried full size to the final termination point.

603.2.4.3 Rating Suction fans must be capable of developing minimum flows of at least 100 cfm, at 1 inch water column pressure.

604 CRAWLSPACE VENTILATION

604.1 Active Ventilation of the Crawlspace Structures that rely upon active (fan-driven) ventilation of the crawlspace for radon control, shall utilize fans rated for continuous operation, and shall be equipped with a fan failure warning device as specified in Section 603.2, and shall have a thermal overload with automatic reset feature.

604.1.1 Vents Vents connecting the crawlspace with outside air shall be sized and located as required to provide mitigation of the indoor radon concentration as demonstrated by post-mitigation test, and shall not be equipped with operable louvers or other means for adjustment by building occupants. Where adjustable vents are used, they shall be permanently fixed in the proper adjustment by the mitigation contractor.

604.1.2 Plumbing Plumbing located in the crawlspace shall be adequately protected from freezing by insulation or means other than restriction of ventilation air.