RADON ABATEMENT
Controlling Radon Gas in Residential Construction

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Radon Abatement: Controlling Radon Gas in Residential Construction

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Course Expiry Date: 09/10/2027

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Purpose and Learning Objectives

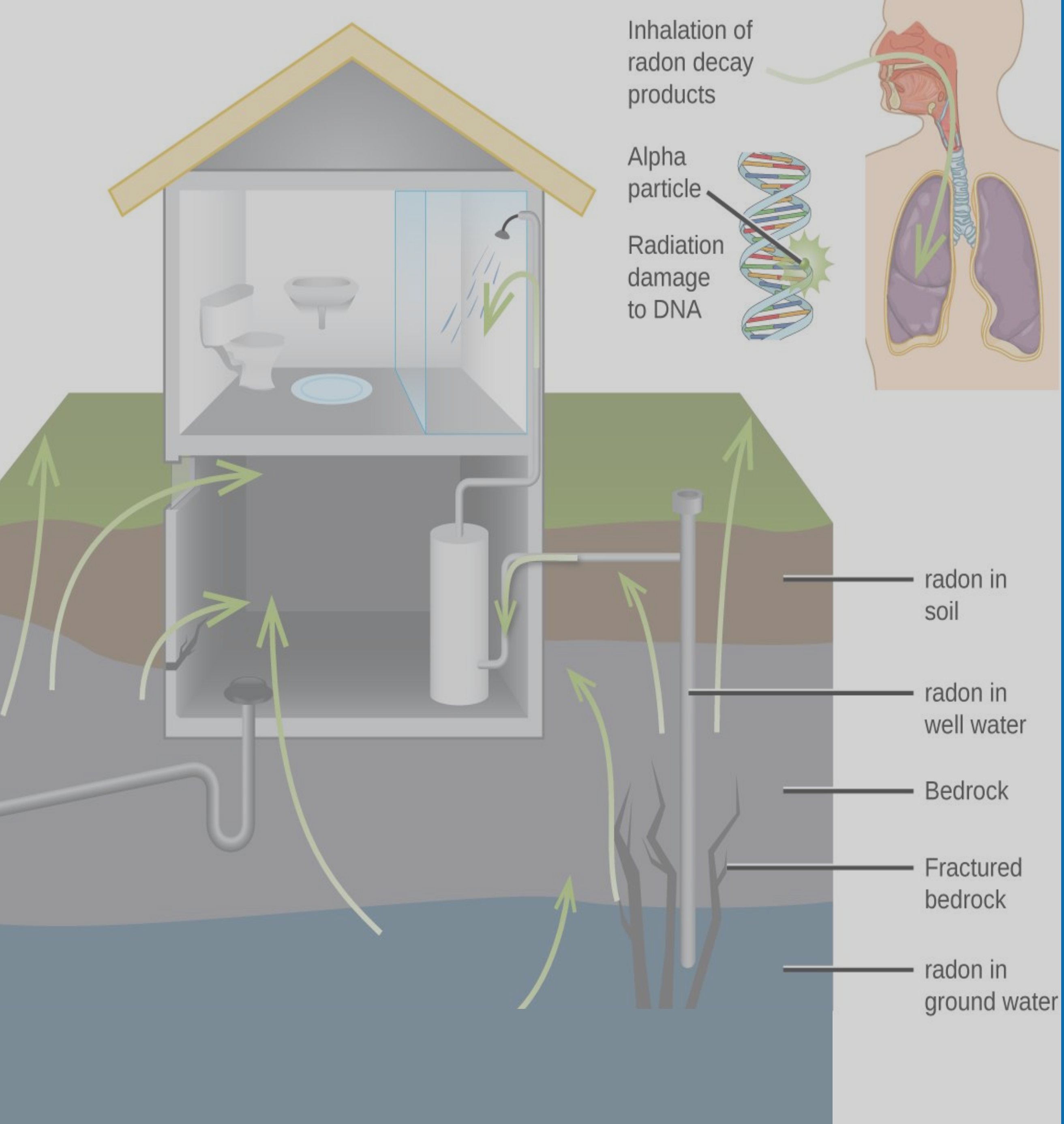
Purpose:

Radon is a colorless, odorless gas, a Class A carcinogen, the leading cause of cancer after smoking, and the leading cause of death for nonsmokers. It is found in soil, rock, and groundwater. If radon enters a home through slabs, basements, and crawl spaces, breathing it can lead to illness or even death. This course examines how the gas travels through soil and into structures and the various interception approaches and materials that can be utilized to prevent entry into inhabited spaces. It also highlights building code requirements and language that can assist with ensuring the correct radon interception systems are designed and installed effectively.

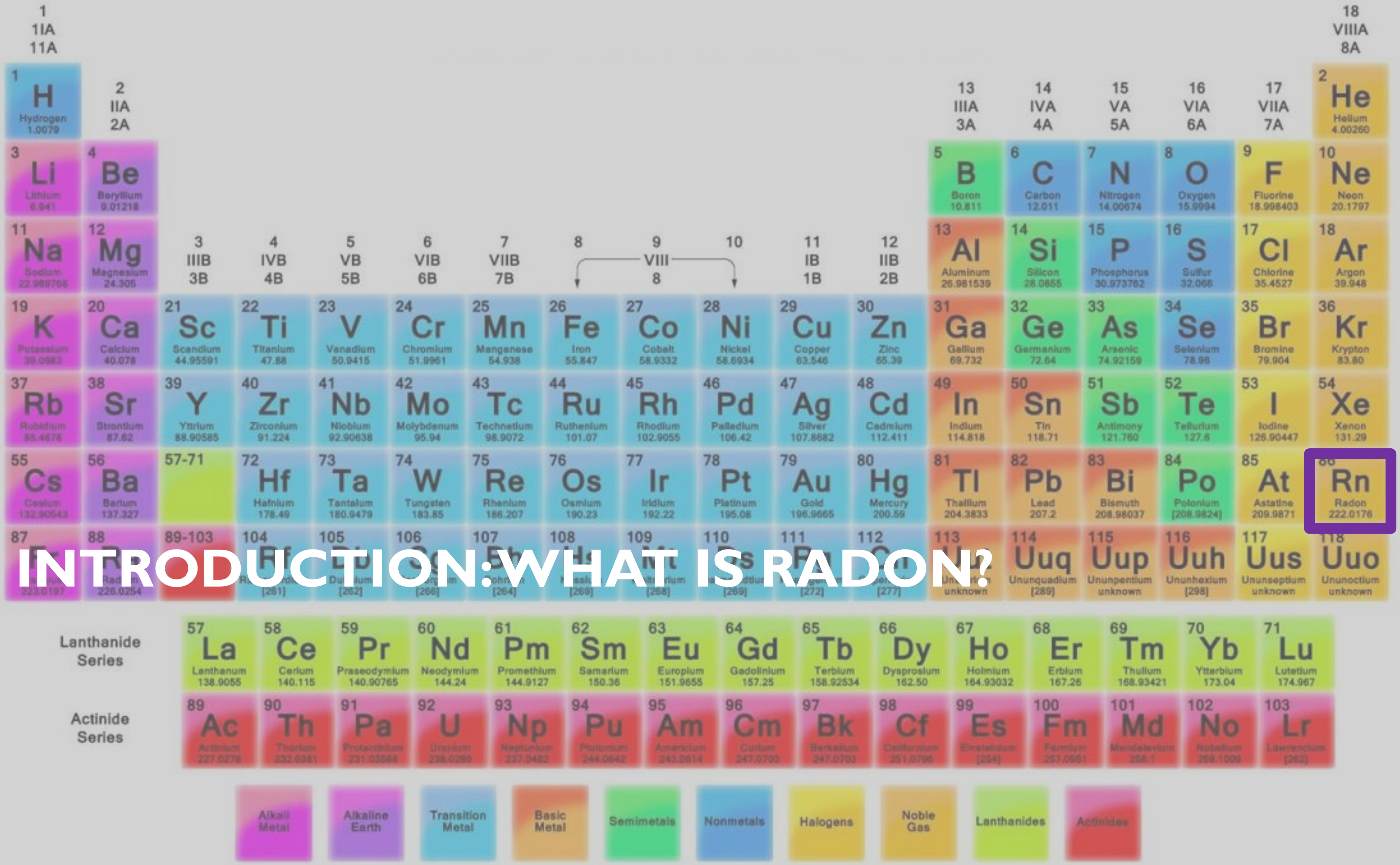
Learning Objectives:

At the end of this program, participants will be able to:

- recall the attributes and behavior of radon gas when designing residential projects
- determine the level of threat of radon and how it may enter a house to the detriment of occupant health
- design and integrate a 3D vent and drainage mat system where appropriate to intercept and dissipate radon to maintain a healthy indoor environment, and
- determine whether subslab, crawl space, or subsurface encapsulation systems should be utilized and how they should be designed to promote occupant health and safety.


Inhalation of radon decay products
Alpha particle
Radiation damage to DNA
radon in soil
radon in well water
Bedrock
Fractured bedrock
radon in ground water

Contents



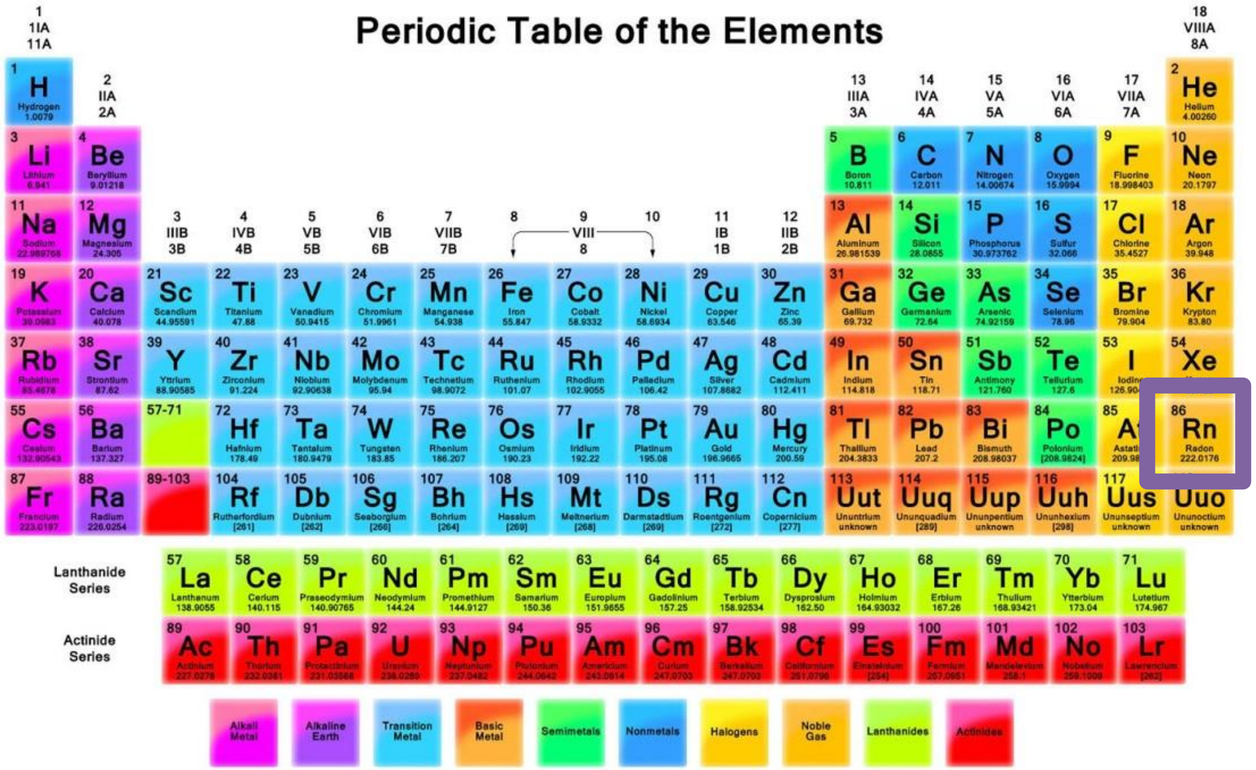
INTRODUCTION: WHAT IS RADON?

Introduction: What Is Radon?

Radon appears in the periodic table as atomic number 86, a gas at room temperature.

It is a colorless, odorless, radioactive gas that comes from the natural decay of uranium found in nearly all soils.

It's considered a noble gas, one of a group of elements thought to be unreactive or hard to combine with other elements.

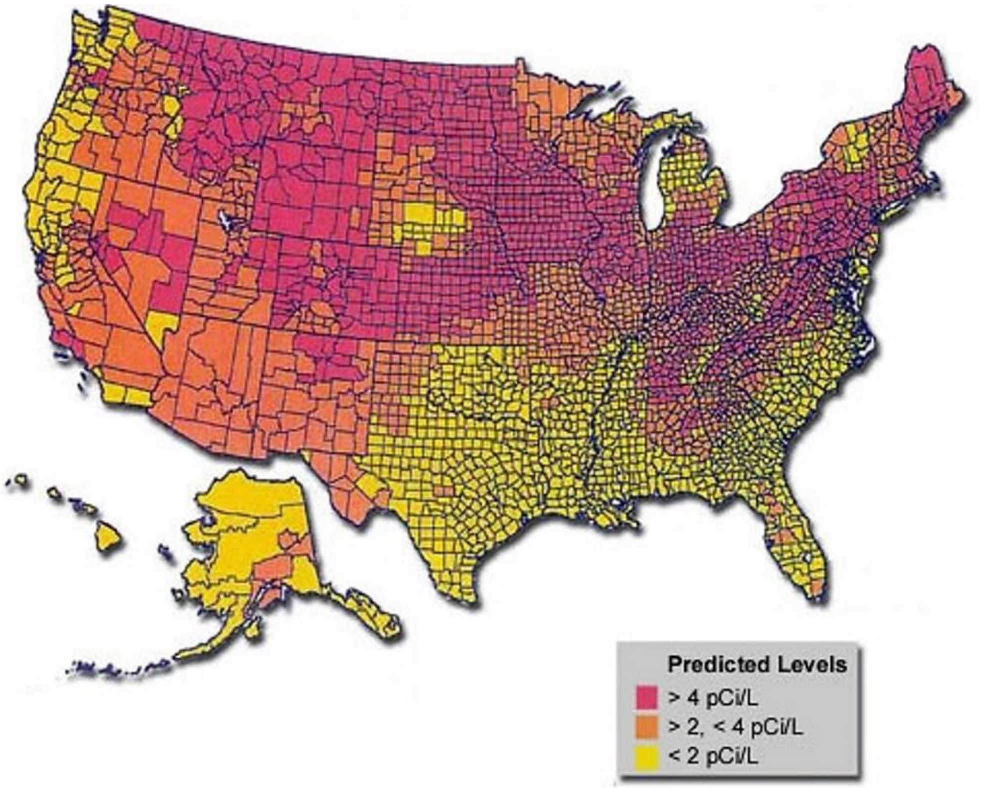


Introduction: What Is Radon?

When atoms of uranium-238 decay, they produce several generations of other radioactive elements. The fifth generation is radium, which in turn decays into radon.

Radon, found in soil, bedrock, and groundwater, has the dangerous tendency to seep into homes and buildings through basements, crawl spaces, and any small subsurface crack or opening. Once inside, it can accumulate, be inhaled, and become a serious health risk to occupants.

This US Environmental Protection Agency (EPA) map shows that radon is present in the soil everywhere in the country. While it is found at different levels or concentrations in different places, it is present to some degree in nearly all soils.

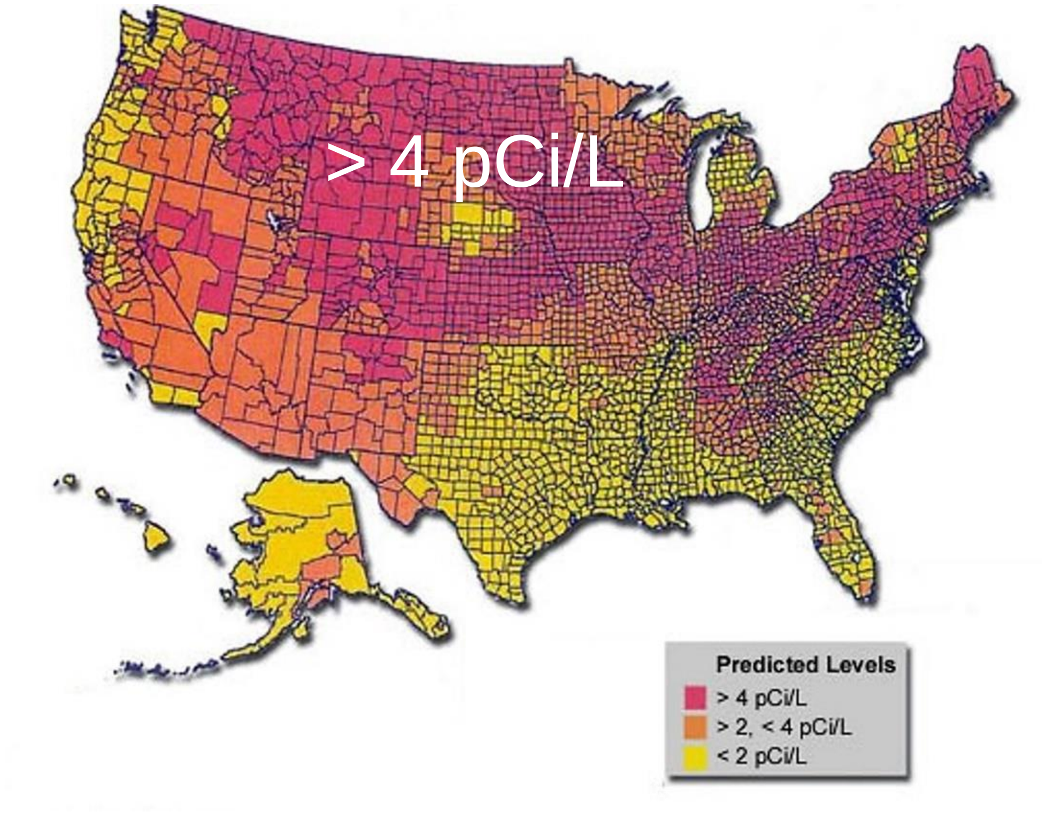


Introduction: What Are Radon Concentration Levels?

Radon concentrations are measured in pCi/L (picocuries/liter). The EPA recommends installing a radon interception system in buildings where the radon concentration in the soil tests at the national action level (NAL) of > 4 pCi/L (150 Bq/m^3).

The reddest areas on the map designate the highest concentrations. In building codes, these areas and concentrations are often referred to as zone 1.

Every state has some areas at this level, and codes mandate interception systems to be installed in those areas. For regions that read between > 2 pCi/L and < 4 pCi/L, where interception may seem to be optional, designers should still consider a mitigation system to minimize risk because there is a likelihood that some residents will get lung cancer.

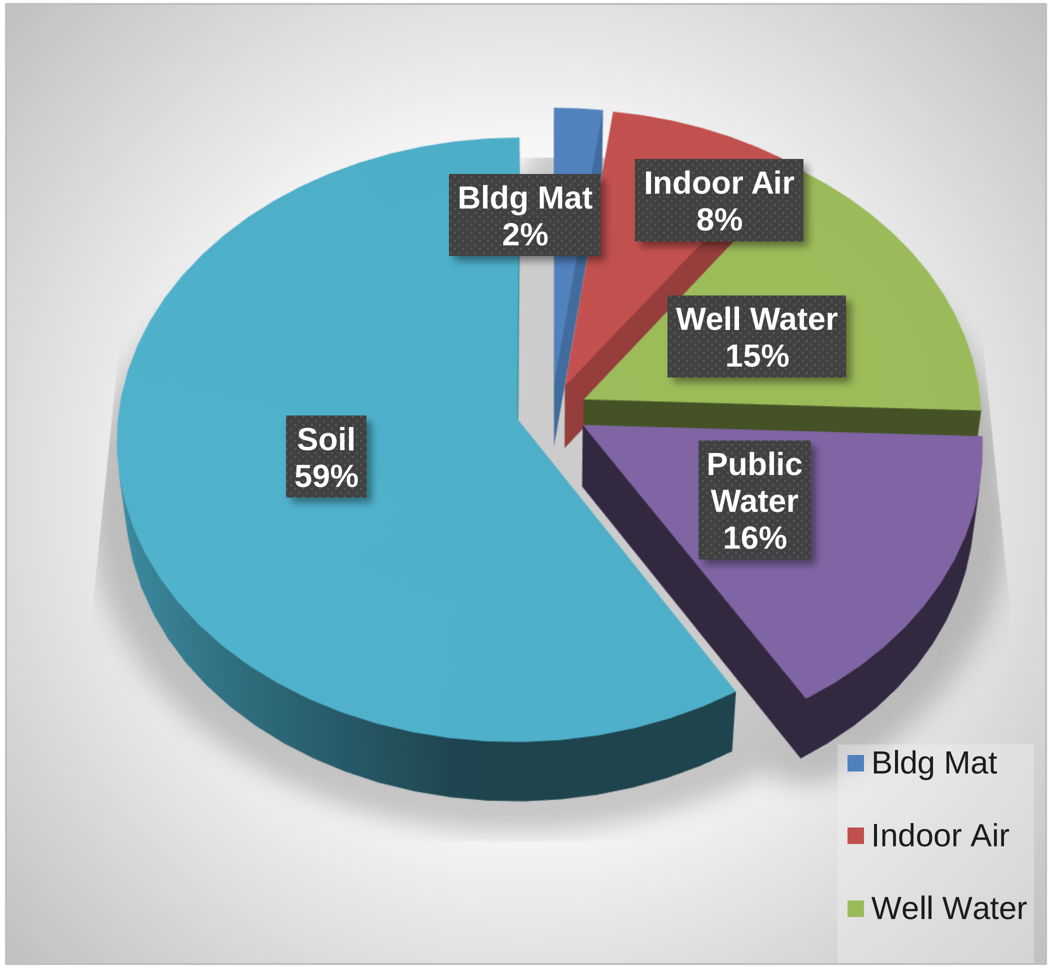


The EPA classified radon as a carcinogen in 1988. Radon is responsible for **21,000 lung cancer deaths annually (58 daily)** and is the second-largest killer after smoking and the number-one killer for nonsmokers.

Introduction: Where Can Radon Be Found?

While the soil under and around a house is by far the largest source of radon gas, radon is also found in other locations, such as public water and well water.

To a lesser degree, it is also found in elements within the house. These elements include building materials, which could also contain elements that were once in the ground.



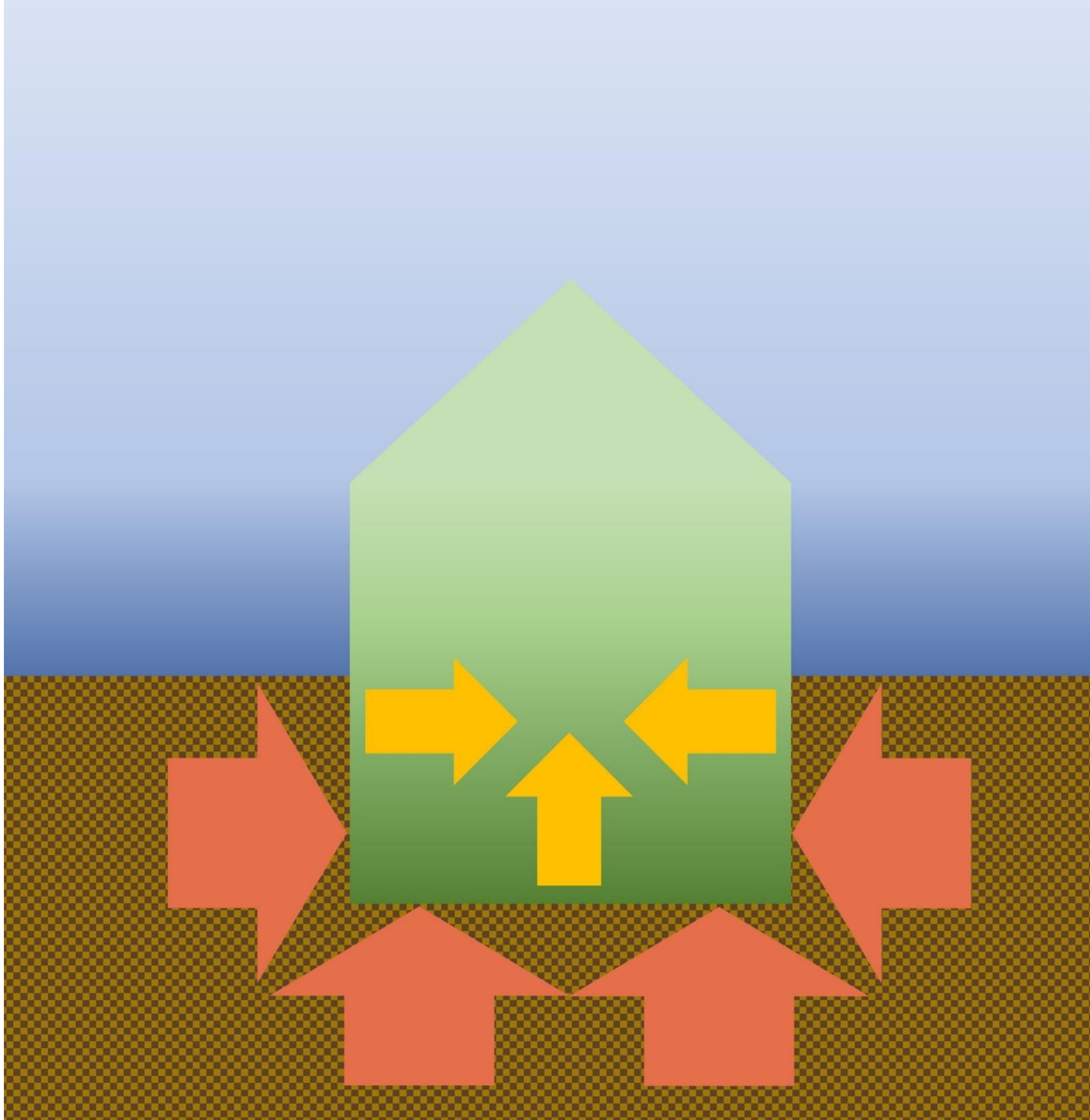
Radon Movement

Several different forces cause radon gas to enter a home from the ground. They are all derived from various external and internal pressures.

External pressures include source accumulation and hydrostatic pressure resulting from water in the soil.

Internal pressures from within the house include negative pressure, such as suction and stack or chimney effect.

The following few slides explore these pressures and their impacts in greater detail.



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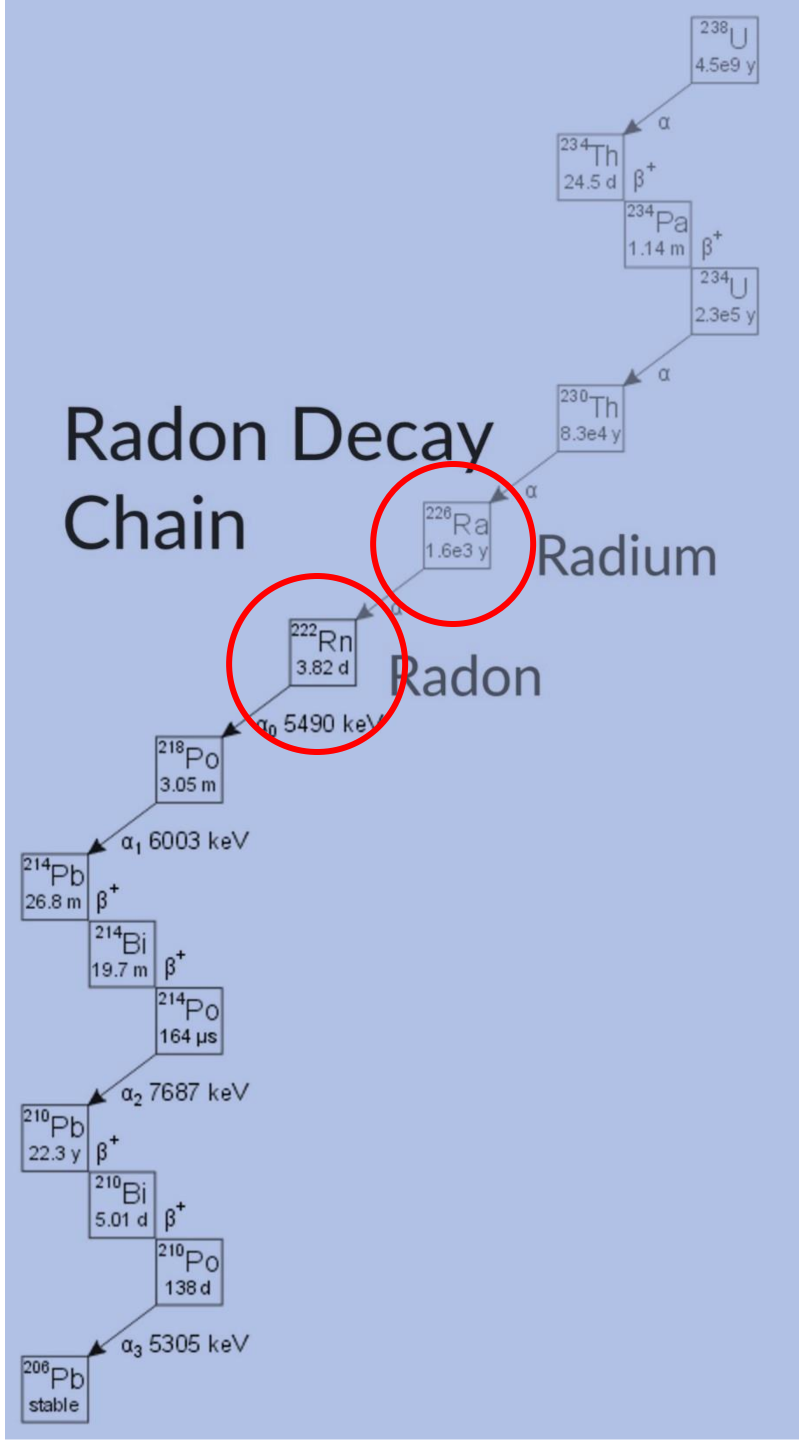
Source Accumulation of Radon Gas

Source accumulation occurs over time, and concentration in the soil builds as decay and breakdown progress.

The adjacent image shows radium and then radon following it on the decay chain.

This decay process increases the gas pressure in the soil. The increased pressure eventually forces radon gas into the structure through even the tiniest openings, such as cracks or joints in the foundation walls or basement slab.



Hydrostatic Pressure

Hydrostatic pressure is an external pressure usually related to rain events. It is simply the water under pressure in the ground that also causes basement leaks.

Radon accumulates in the void spaces between soil particles. When the soil is composed of coarse sand and gravel, it becomes highly permeable, allowing radon to move through it with alarming ease.

When the soil becomes saturated, radon is forced out of gaps and into the building. This usually occurs beneath the slab or through below-ground perimeter walls.

Structures built on highly permeable soils and bedrock are more likely to have higher levels of radon.

Negative Pressure: Human Activities

There are a number of human activities that can create negative pressures inside the home and suck radon gas into a structure through subsurface constructions.

These activities include:

- running clothes dryers that exhaust air from the home to the exterior
- operating fireplaces or wood stoves that do not use any dedicated external air sources
- turning on bathroom vent fans or kitchen exhaust hood fans that connect to the outdoors, and
- exterior forces such as wind when it exhausts indoor air from the lee side of a building through wall cracks and openings.

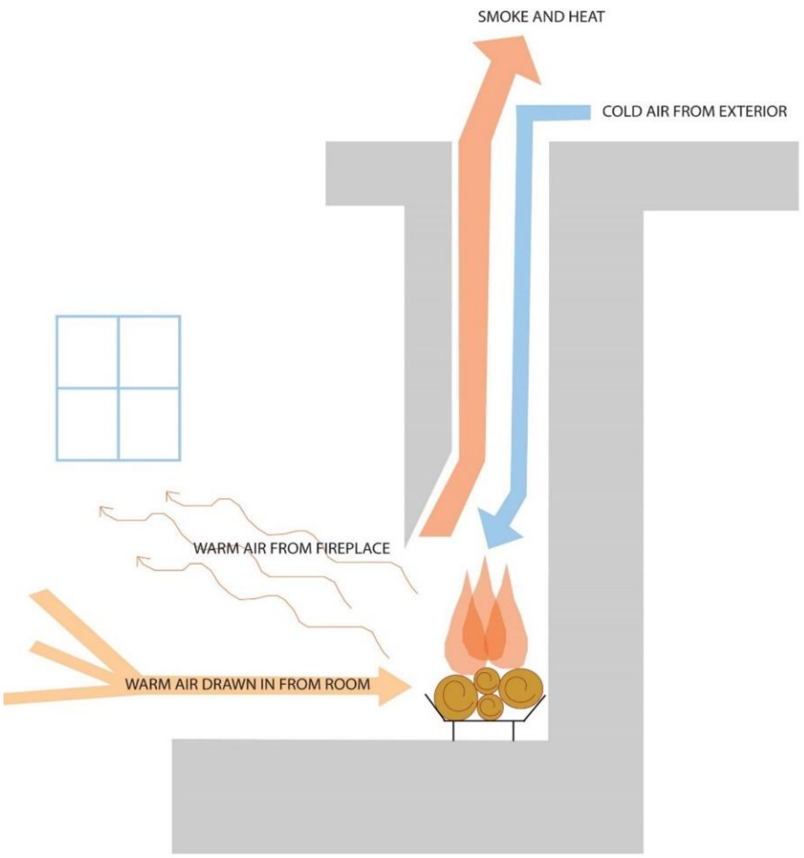
Radon gas can replace the consumed/exhausted air when such negative forces occur.

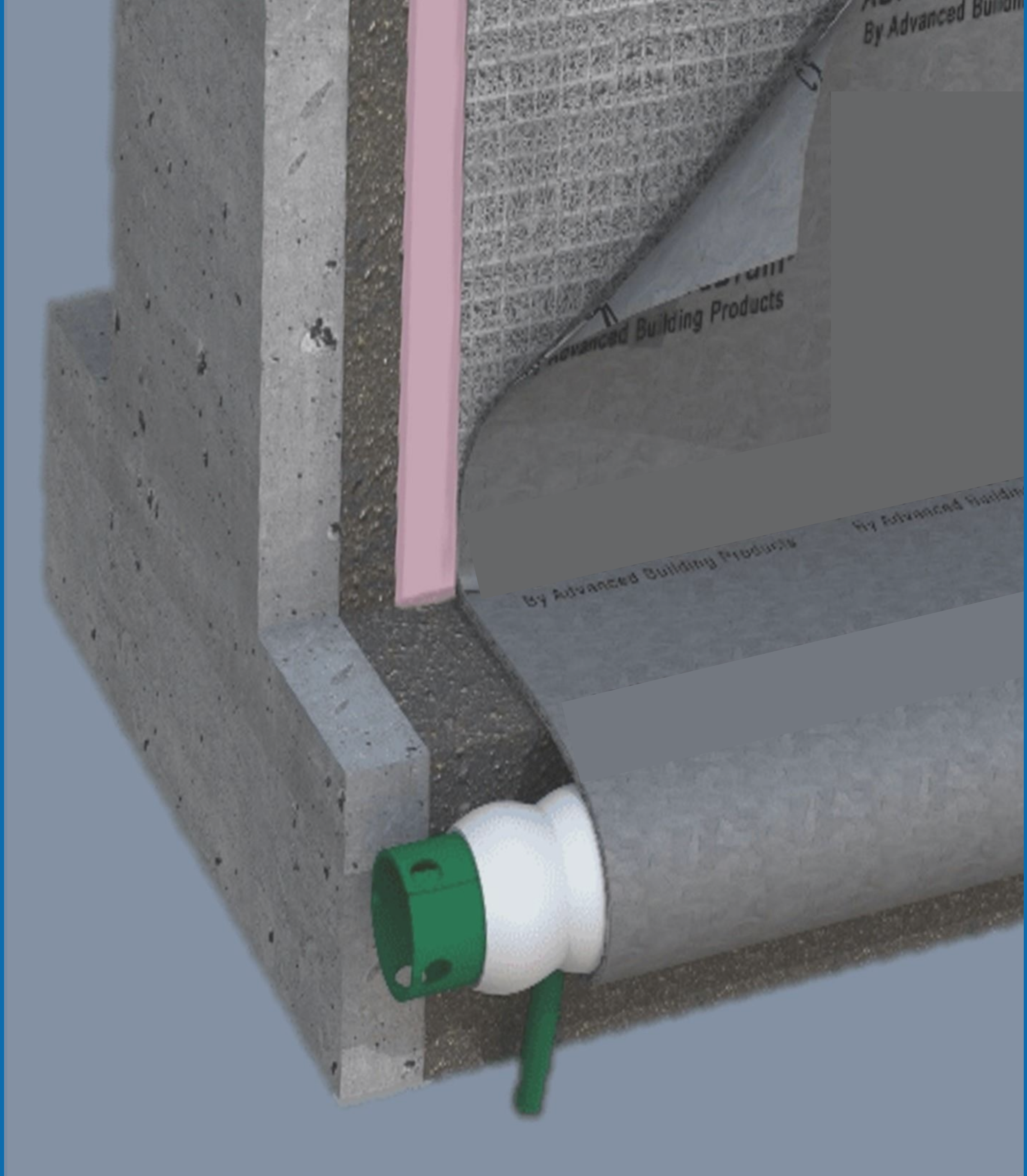
Negative Pressure: Stack Effect

Buoyancy is the physical mechanism by which warm air rises above cooler air. Air temperature and moisture content each affect buoyancy.

The stack or chimney effect is the tendency for warm air to move vertically through buildings and escape out the top. It occurs when cool, moist air enters a house through crawl spaces or basements and travels up through the floors and walls as it warms. Hot air rises, and the warmer buoyant air exits the building through a variety of openings, including small cracks in the walls, around windows of the upper floors, and through the roof or attic.

The stack effect can also be accelerated by human activity. For instance, consider a chimney. When a fire is lit, it warms the air inside the chimney, causing it to rise. This rising warm air then draws in cooler room air from below, creating a draft by pulling in outside replacement air through wall openings or cracks into the space. However, if the fireplace has a dedicated, sealed, controlled outdoor air source, this draft does not occur.





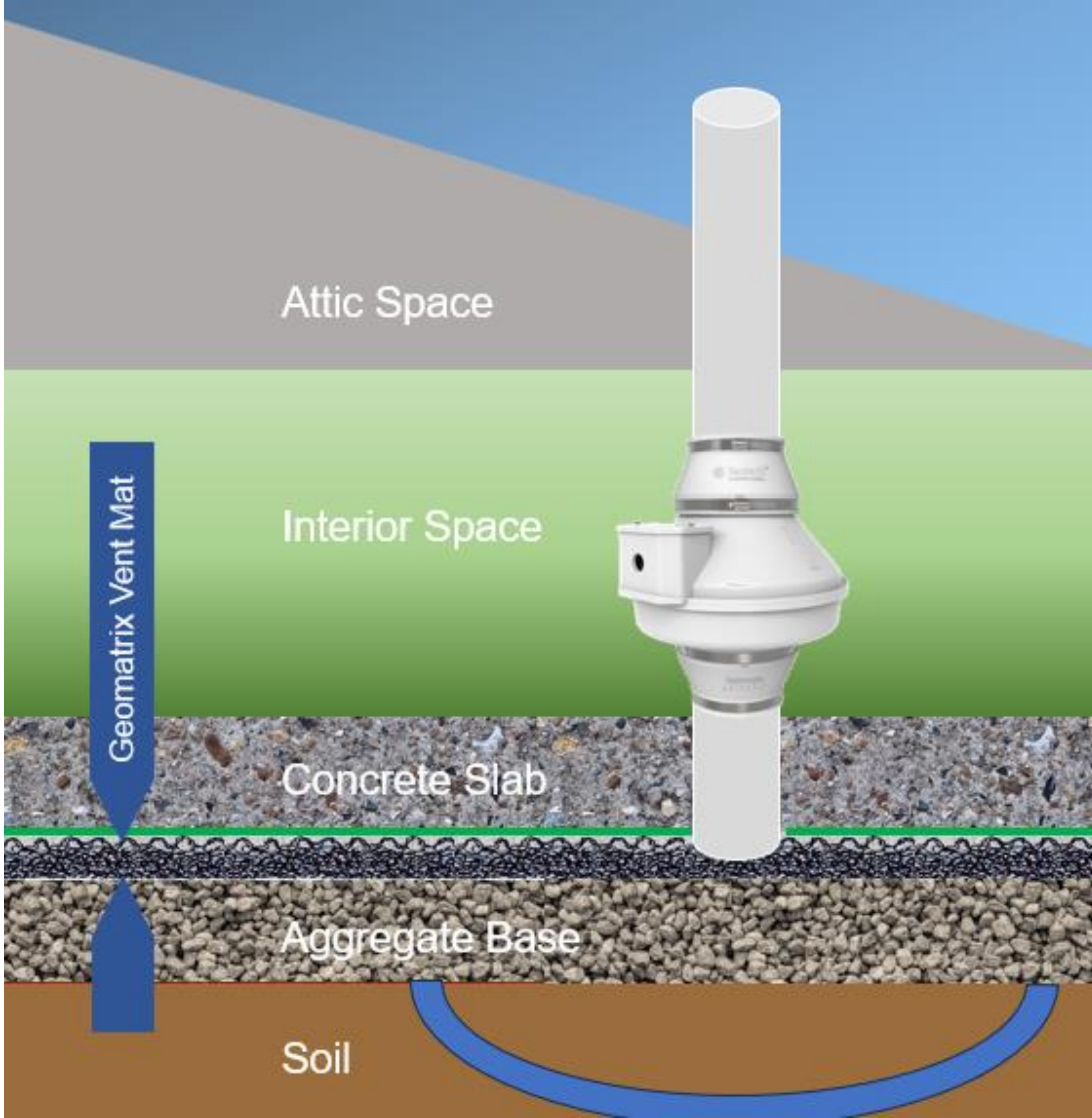
RADON INTERCEPTION SYSTEMS

Radon Interception

Radon gas is dangerous and odorless and can enter a building in various ways from external or internal negative pressures without notice. Therefore, a system to intercept it before it enters any inhabited space must be put in place.

Once intercepted, the system must then safely channel it away before it enters the house.

A radon abatement geomatrix vent mat below a basement slab provides an open zone to intercept radon so it can be safely evacuated through a pipe system to above the roof and then to the atmosphere.



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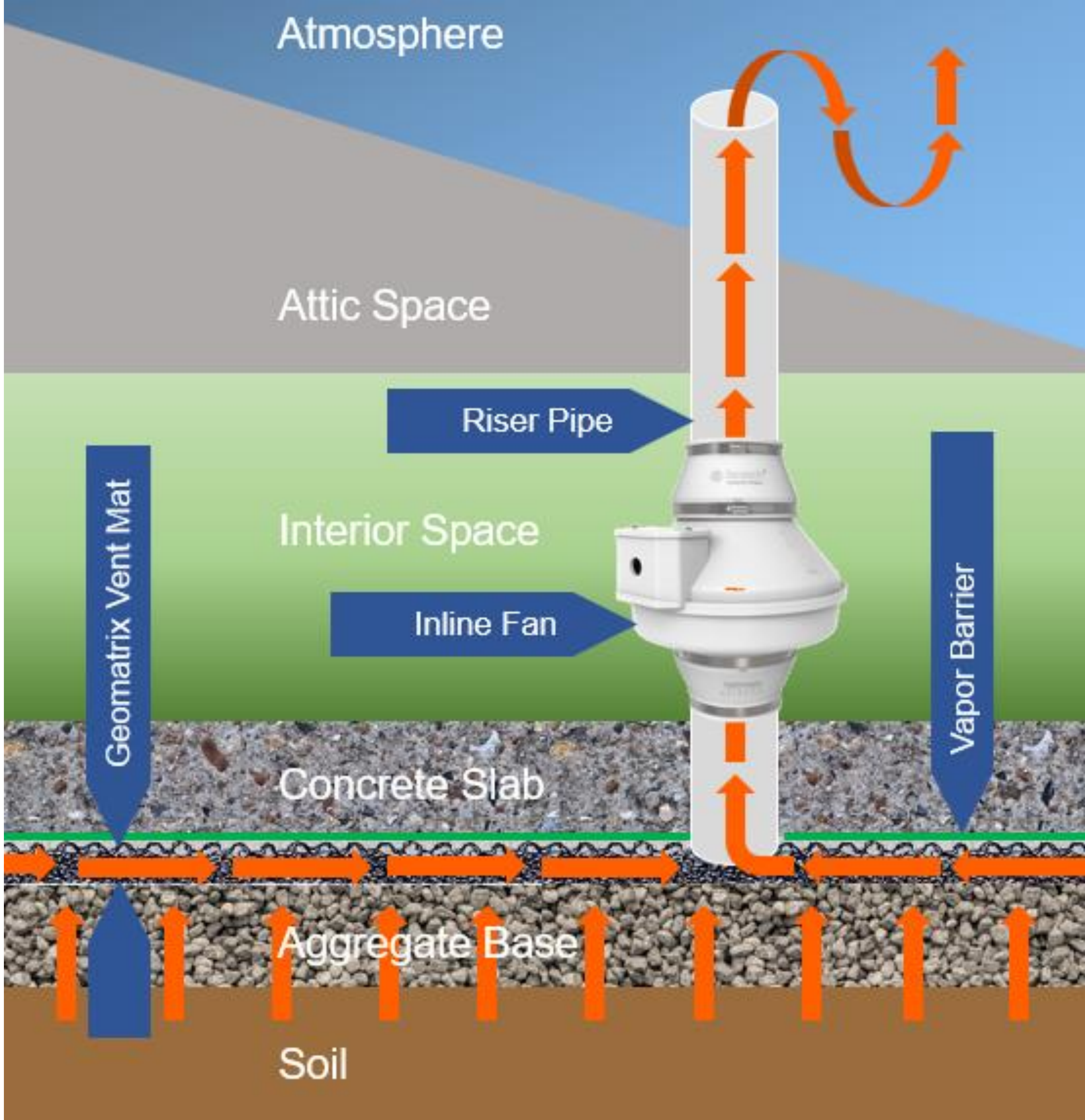
Radon Interception

Vent mats are the first line of defense to capture radon as negative pressures begin to draw it inward. They are part of a complete radon interception system. The typical components of the subslab system are:

- a 3D geomatrix vent mat and/or a drainage mat overlay
- a vapor barrier, and
- a riser pipe that can include a fan to make it an active system.

Note that there is also aggregate under the slab. The mat does not replace underslab aggregate.

Trace the orange arrows in the image to see the radon venting path through the mat and the pipe.



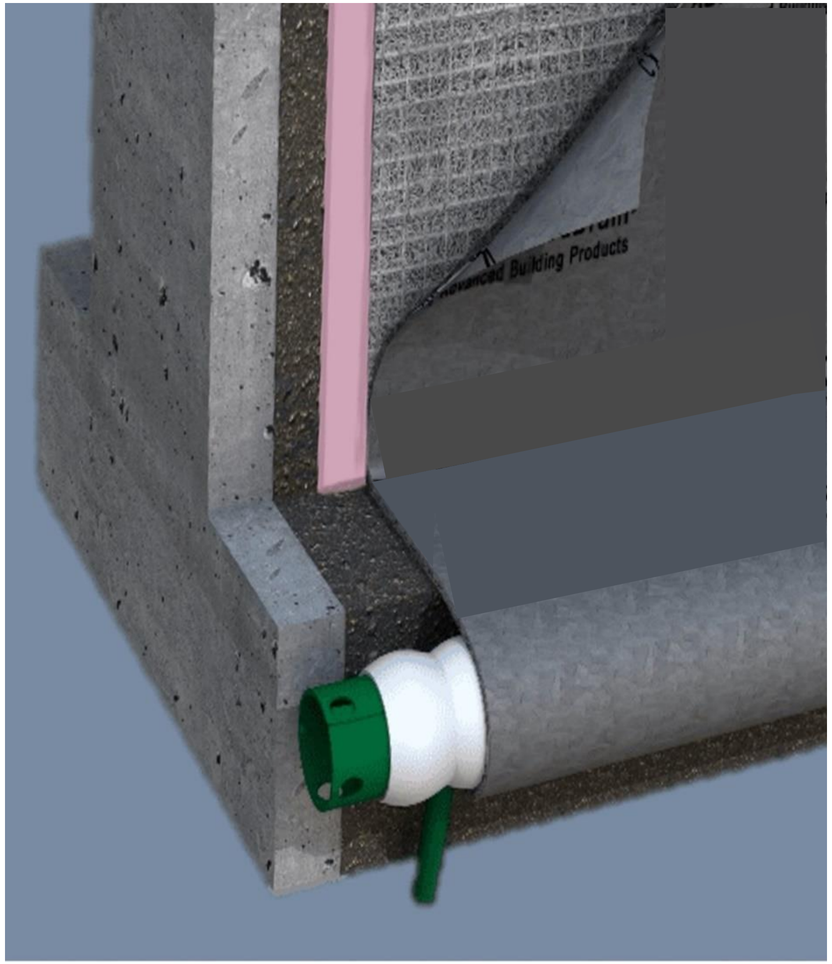
Radon Mitigation Systems

There are three components that might form a mitigation system.

The **subslab grid** traps radon gas using the vent mat and moves it toward the riser pipe. Using the suction created by an inline fan, the riser pipe moves the gas upward through the structure and out through the roof, where it dissipates into the atmosphere.

A **crawl space overlay** also gathers and traps radon gas in the soil below the vapor barrier and moves it to a riser pipe.

Subsurface wall encapsulation (image) with vertical drainage mats creates an air gap on the outside of the foundation wall, which relieves hydrostatic pressure and intercepts the radon gas before it can enter the building. The same mats also keep the basement dry. The vent strip at the base of the perimeter wall uses negative pressure to suck any radon gas in the perimeter wall into the subslab venting system.



Radon Mitigation

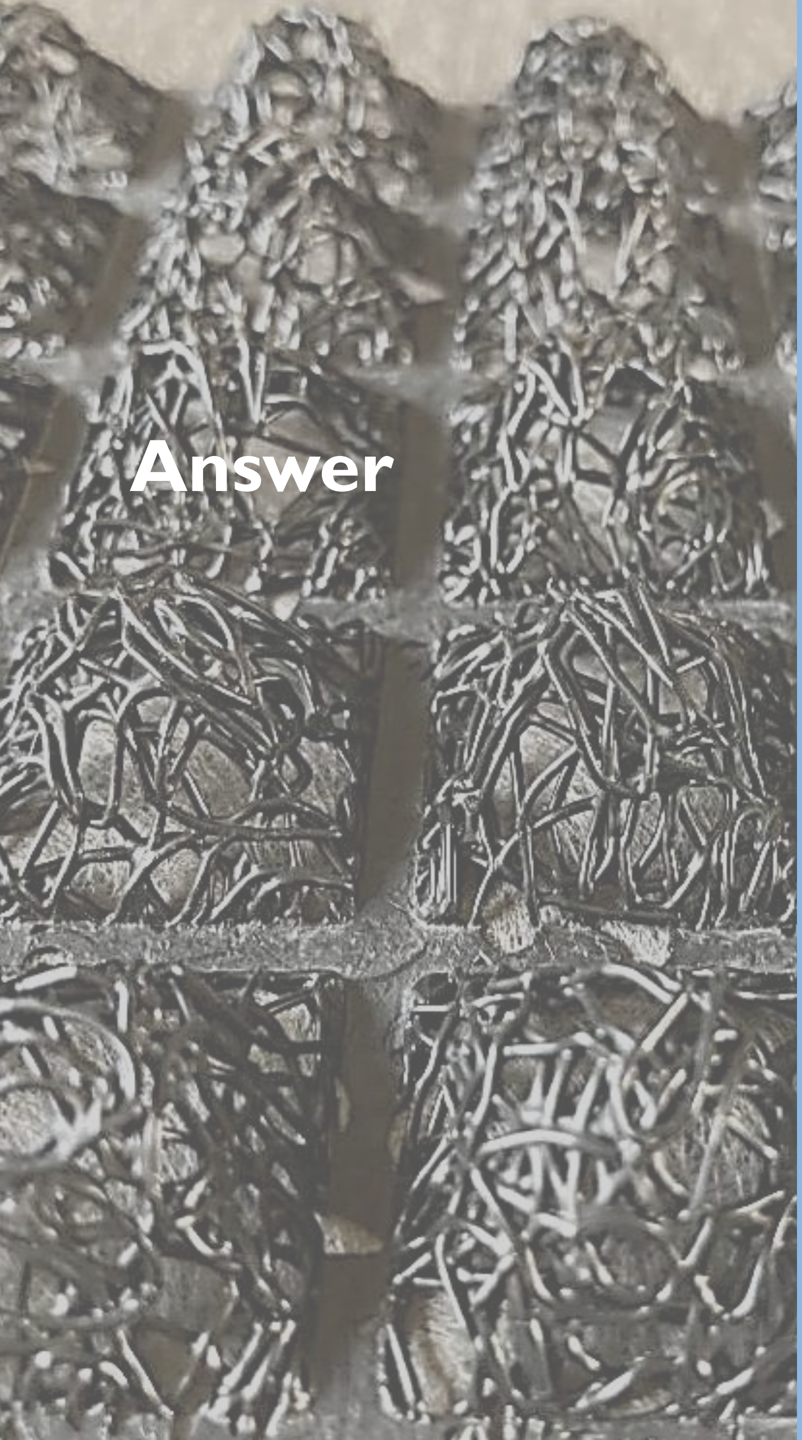
Drainage mats (upper image) and geomatrix vent mats (lower image) are both 3D mats designed to neutralize below-grade forces and provide an alternate pathway for radon gas and moisture flow.

Drainage mats, which are available with fabric on one or both sides of a polymer core, provide filtration and drainage in one package. They can be used on the exterior of perimeter walls or under the slab. They eliminate the need for aggregate backfill when used on the walls but do not eliminate aggregate under the slab.

Geomatrix mats can reduce radon by up to 97%, vent passively without a fan, give slab support, and keep it dry. They prevent subsoil moisture wicking and replace nonuniform pipe and gravel systems.

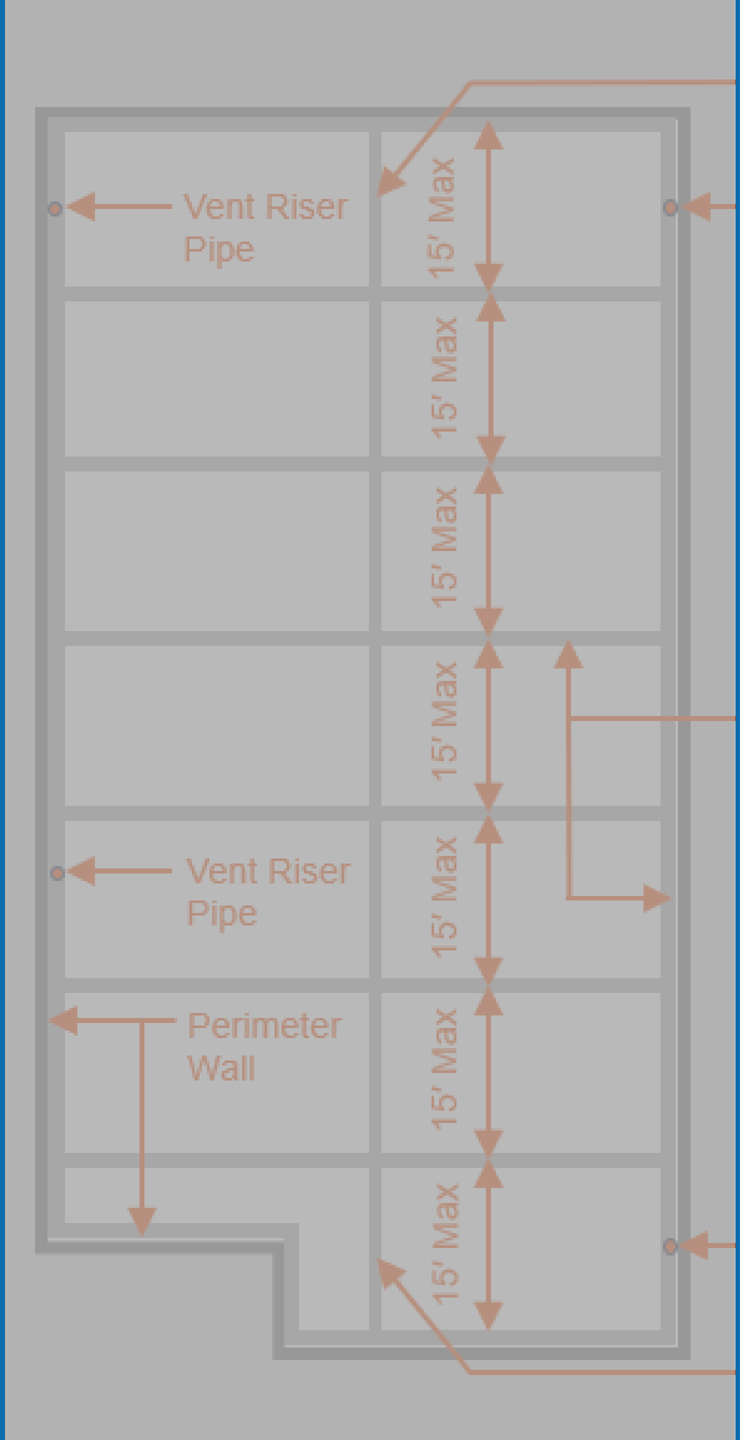
Review Question

Can you recall the radon level at which the EPA recommends installing a radon interception or mitigation system?



Answer

EPA recommends a radon interception system be installed in buildings where the soil tests for radon > 4 pCi/L. It is best practice to consider installing these systems at levels down to > 2 pCi/L.



INSTALLING RADON INTERCEPTION SYSTEMS

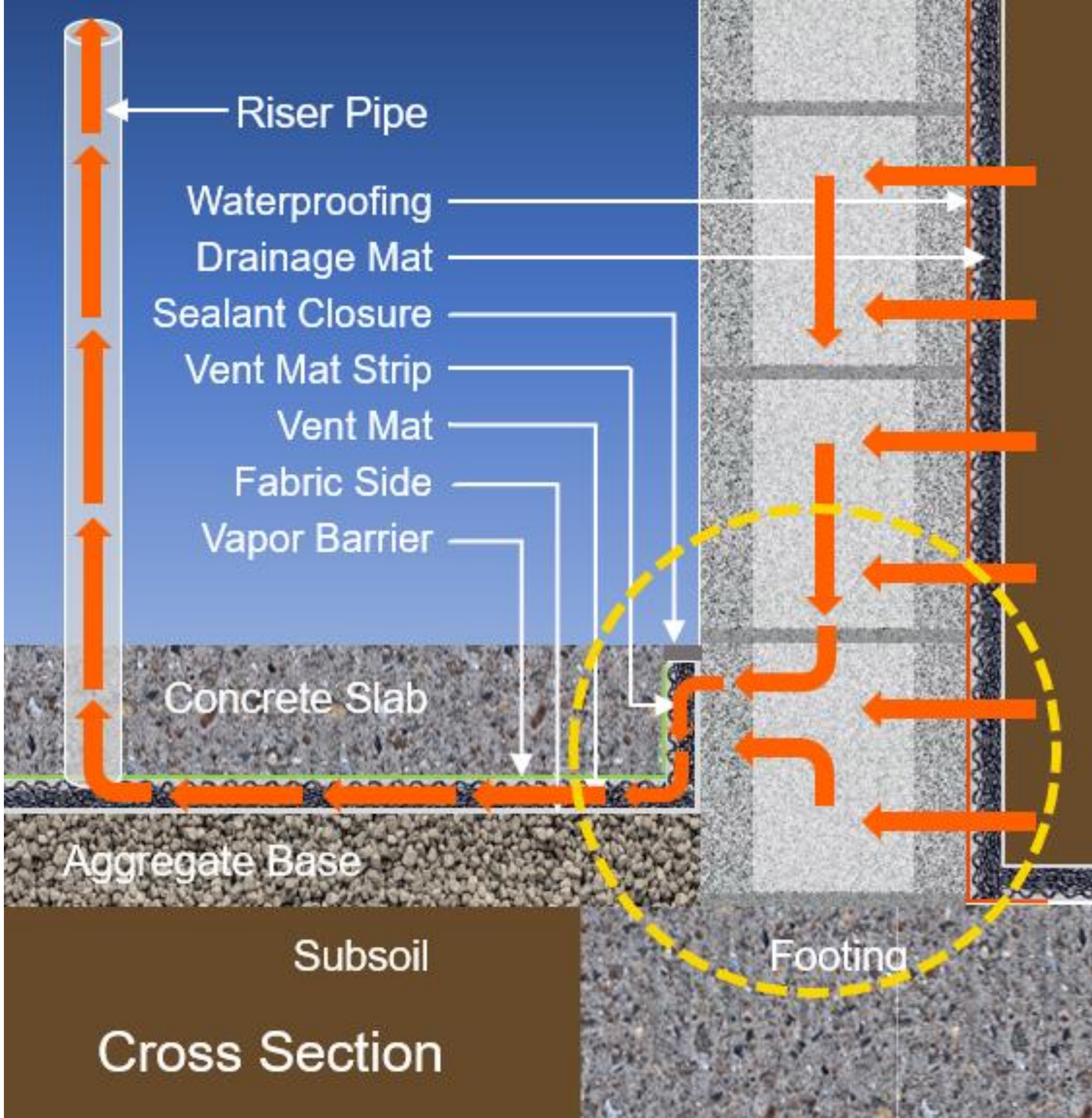
Subslab Grid Vent Mat

The geomatrix vent mat is designed explicitly for subslab grids, primarily in a new building or home construction.

It is placed with the fabric down, and a strip can be turned up along the wall's perimeter where it meets the concrete slab.

This allows the subslab vent system to evacuate radon gas that may have seeped into a below-grade concrete block perimeter wall from the soil.

Once again, follow the orange arrows to see the radon evacuation path from the wall to the atmosphere via the subslab system and then the riser pipe to the atmosphere.



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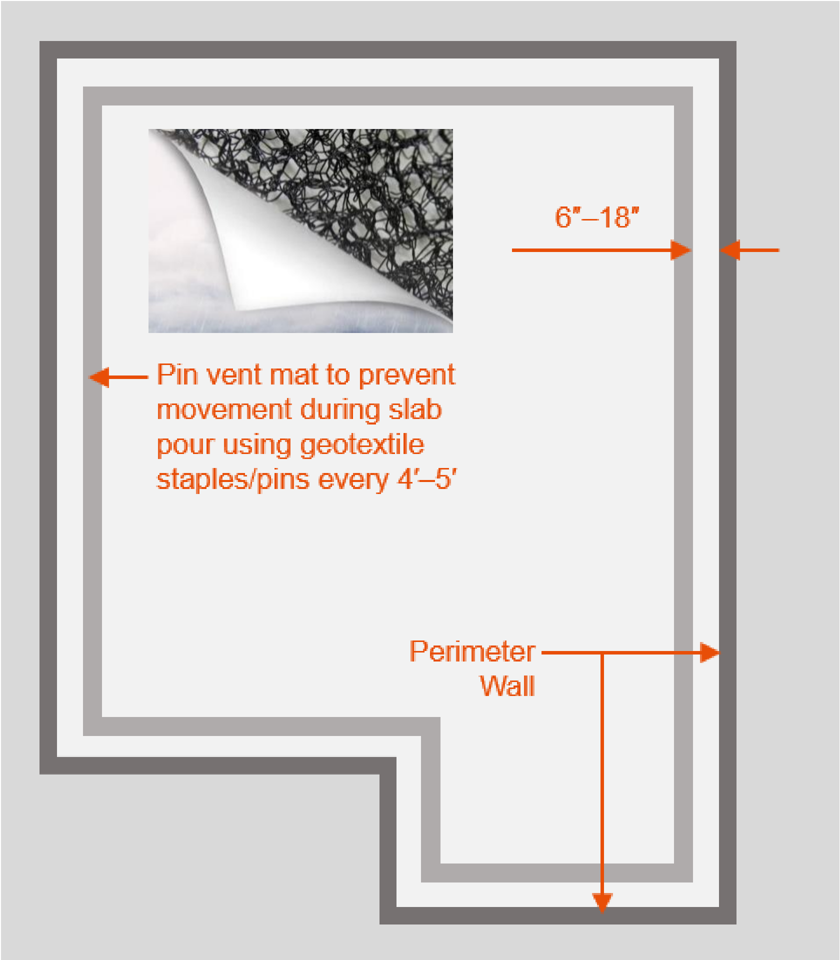
Subslab Grid Vent Mat

To begin the installation of a subslab interception system, a strip of vent mat is placed continually 6″ to 18″ (152 to 457 mm) from the perimeter wall or butting against it.

Geotextile pins are used to hold the strips in place during the concrete pour.



Subslab Grid Fan/Riser Pipe

A riser pipe is extended through the roof for passive ventilation.

A passive system (with no fan) can be used where radon levels are relatively low and where the building displays sufficient stack effect. An inline fan can be used for active subslab ventilation. Designers should consult local experts.

Note: Code requirements for vent pipes are described on later slides.

Subslab Grids: Larger Slabs

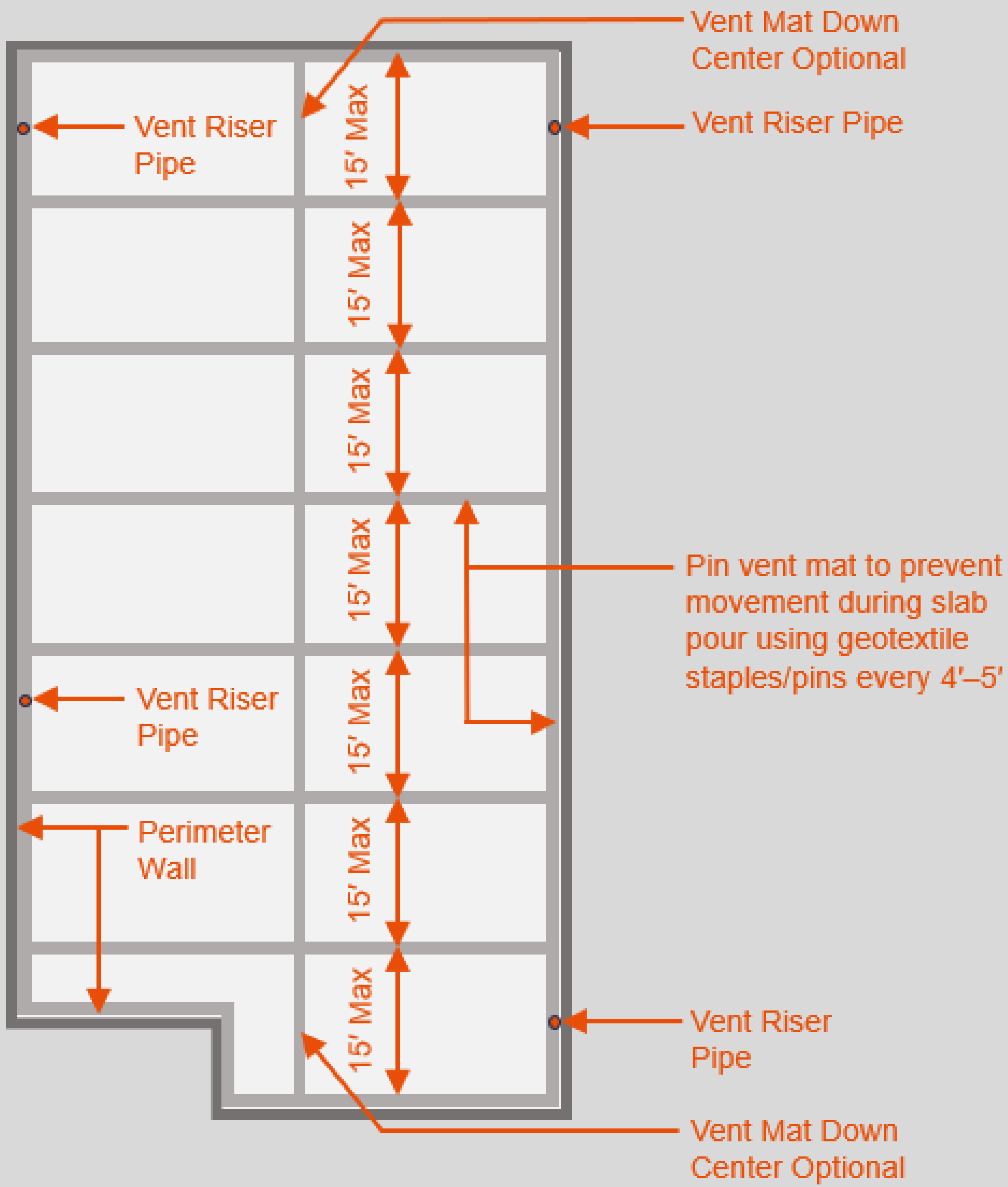
For larger slabs, add more strips of vent mat no more than 15′ (4.57 m) from the other strips.

A strip of vent mat down the center, perpendicular to the other strips, is optional.

Pin with geotextile pins as per other strips.

Install one riser pipe for every 2,000 ft^2 (185m^2) of slab.

See the section on building codes for a more complete description of vent pipe requirements.



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Crawl Space Overlay

For projects with a crawl space with exposed soil, begin by installing a drainage mat (inset image) over the entire area to create a horizontal vent space.

According to EPA testing, 3D drainage mats reduce radon levels in crawl spaces by up to 97%.

Follow this by sealing off the crawl space with a nonpermeable vapor barrier over the entire area.

Crawl Space Overlay

3D drainage mats, installed with the fabric side down, are designed to conform easily to the irregular soil surface.

They supply sufficient cushioning to the vapor barrier while creating a continuous vent space, which allows proper airflow and radon movement beneath it.

Crawl Space Overlay

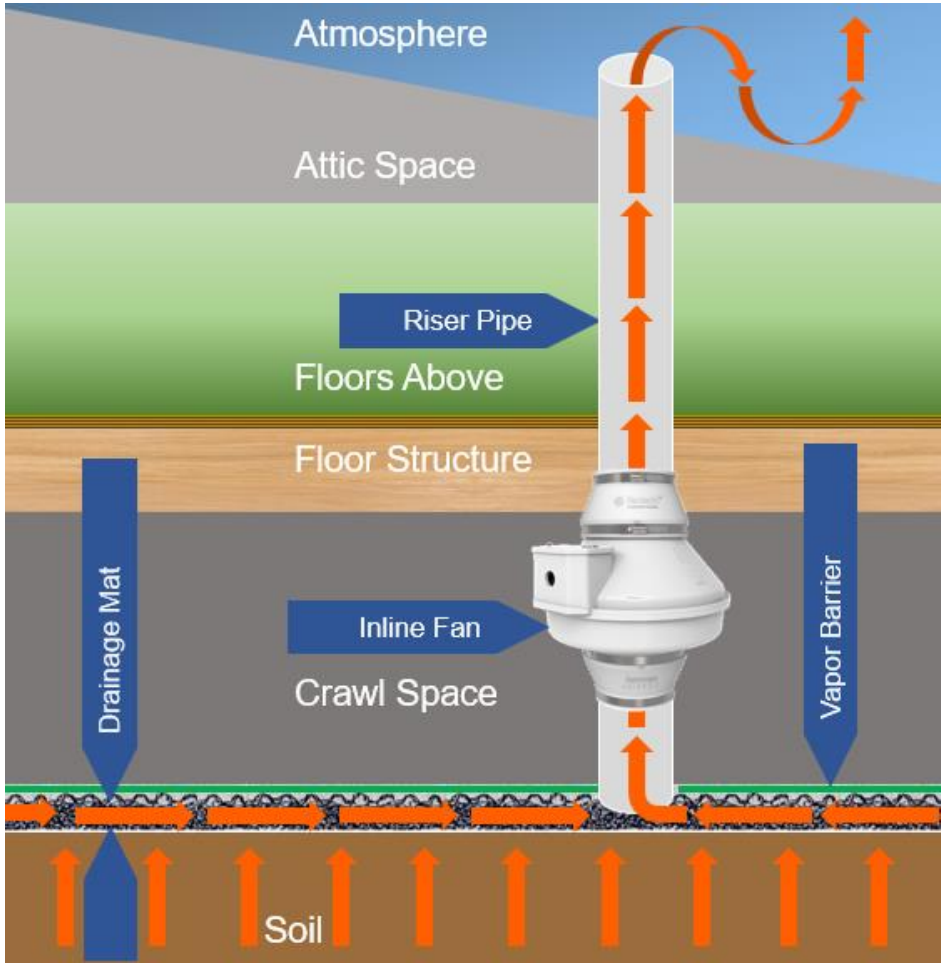
Drainage mats allow the subslab interception system to vent in either a passive or a fan-driven (active) mode.

Drainage mats are the first line of defense in a crawl space abatement system, which typically consists of the following:

- A drainage mat layer

    Note that while drainage mats and geomatrix mats (strips) are both designed for subslab systems, drainage mats that come 39″ (990 mm) wide are used to cover larger areas where complete coverage is required, while geomatrix 10″ and 20″ (254 and 508 mm) wide strips are used to create grids as previously shown.

- A nonpermeable vapor barrier
- A riser pipe
- Inline fan (optional)

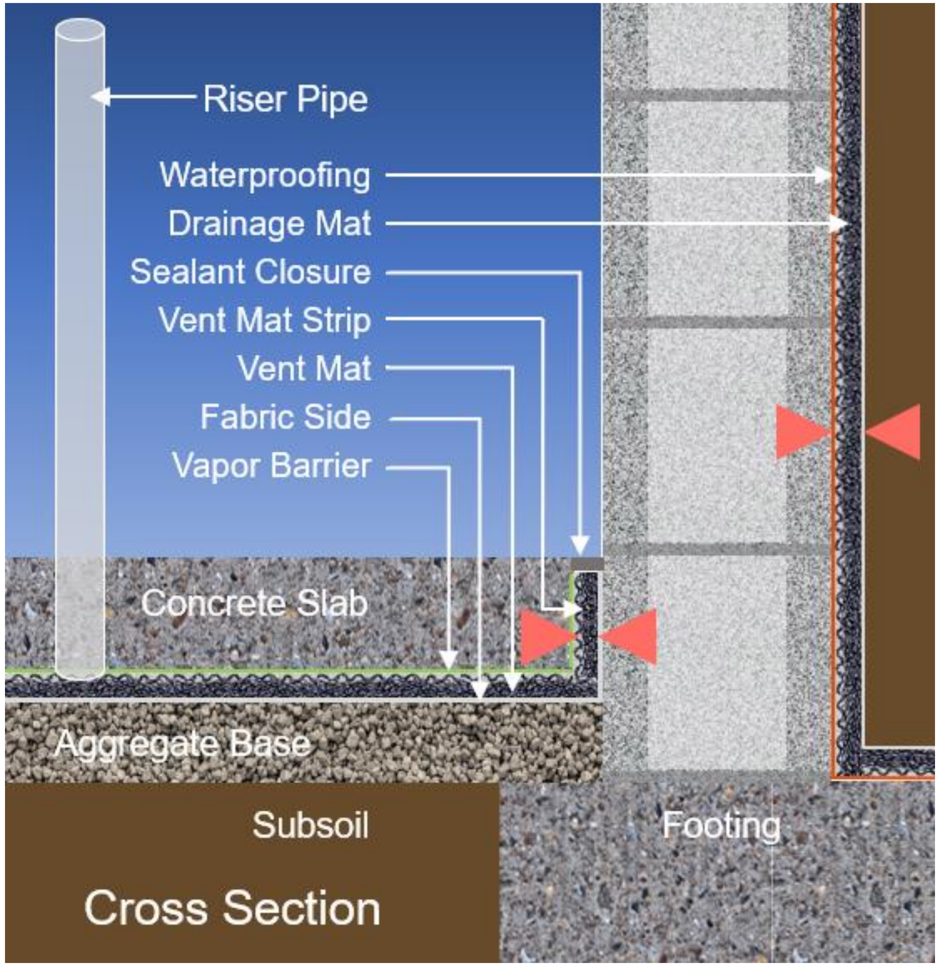


Subsurface Wall Encapsulation: Working with a Subslab Grid

When you combine the subslab grid with a turned-up strip of vent mat, a subsurface wall drain, and subsurface wall encapsulation, you create an integrated exterior/interior system that captures any radon that might have seeped into the block foundation wall as well as any radon that might be in the soil below the basement slab.

The drainage mat on the exterior of the wall relieves the hydrostatic pressure by draining away the groundwater, capturing radon, and keeping the basement wall dry at the same time.

This is a best practice for any basement.

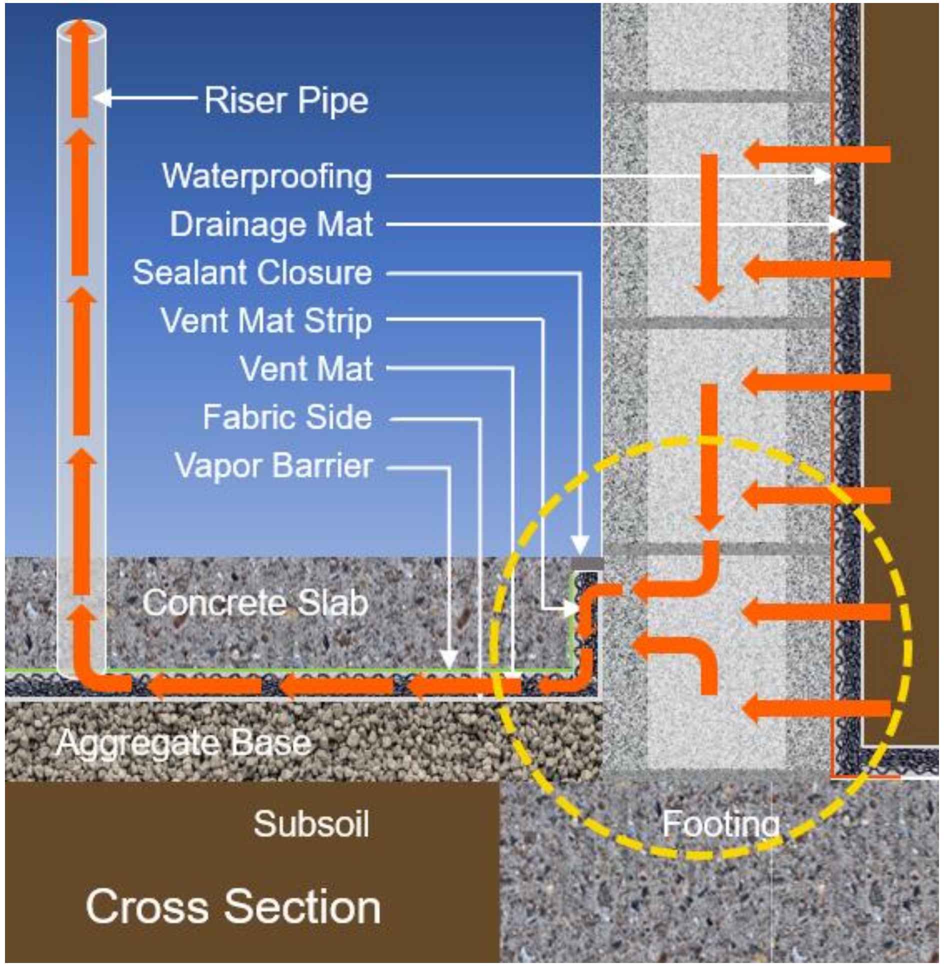


Subsurface Wall Encapsulation: Working with a Subslab Grid

Hydrostatic pressure also pushes radon gas to the foundation wall, primarily to the basement wall/slab joint, a vulnerable spot in the construction.

It removes radon gas in this area by creating a negative pressure zone at the point of greatest likelihood of radon infiltration through the basement slab.

After rain events, radon levels quite often increase because hydrostatic pressure from water accumulation in the gaps where the radon is in the soil pushes radon gas out of those gaps and into basements.

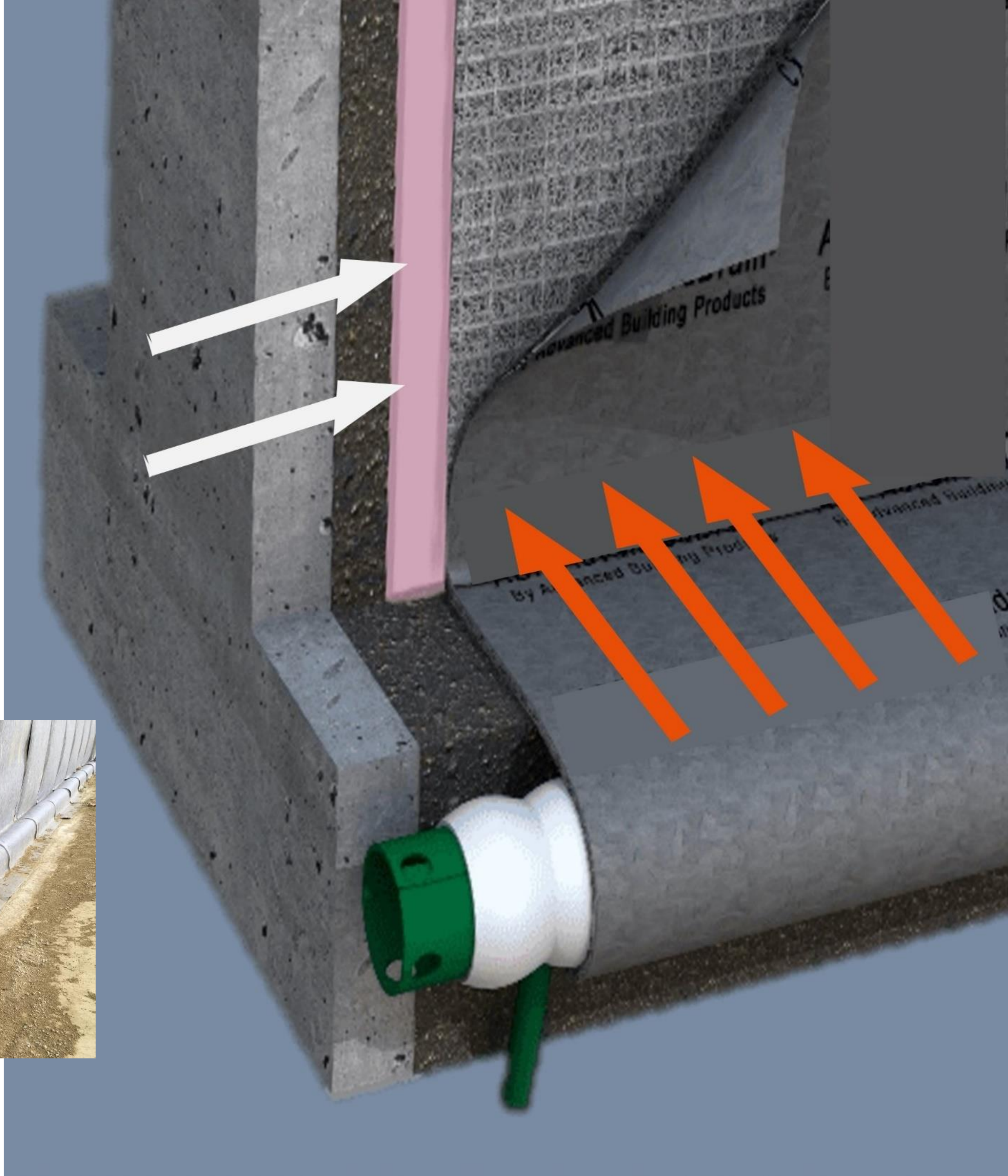


Subsurface Wall Encapsulation

Subsurface wall encapsulation is actually a subsystem of a subslab interception system.

The drainage mat, also applied vertically to the perimeter wall, provides an air gap on the outside of the foundation wall, relieving hydrostatic pressure and intercepting radon before it enters the building.

Later slides show how drainage mats on foundation walls should be installed.

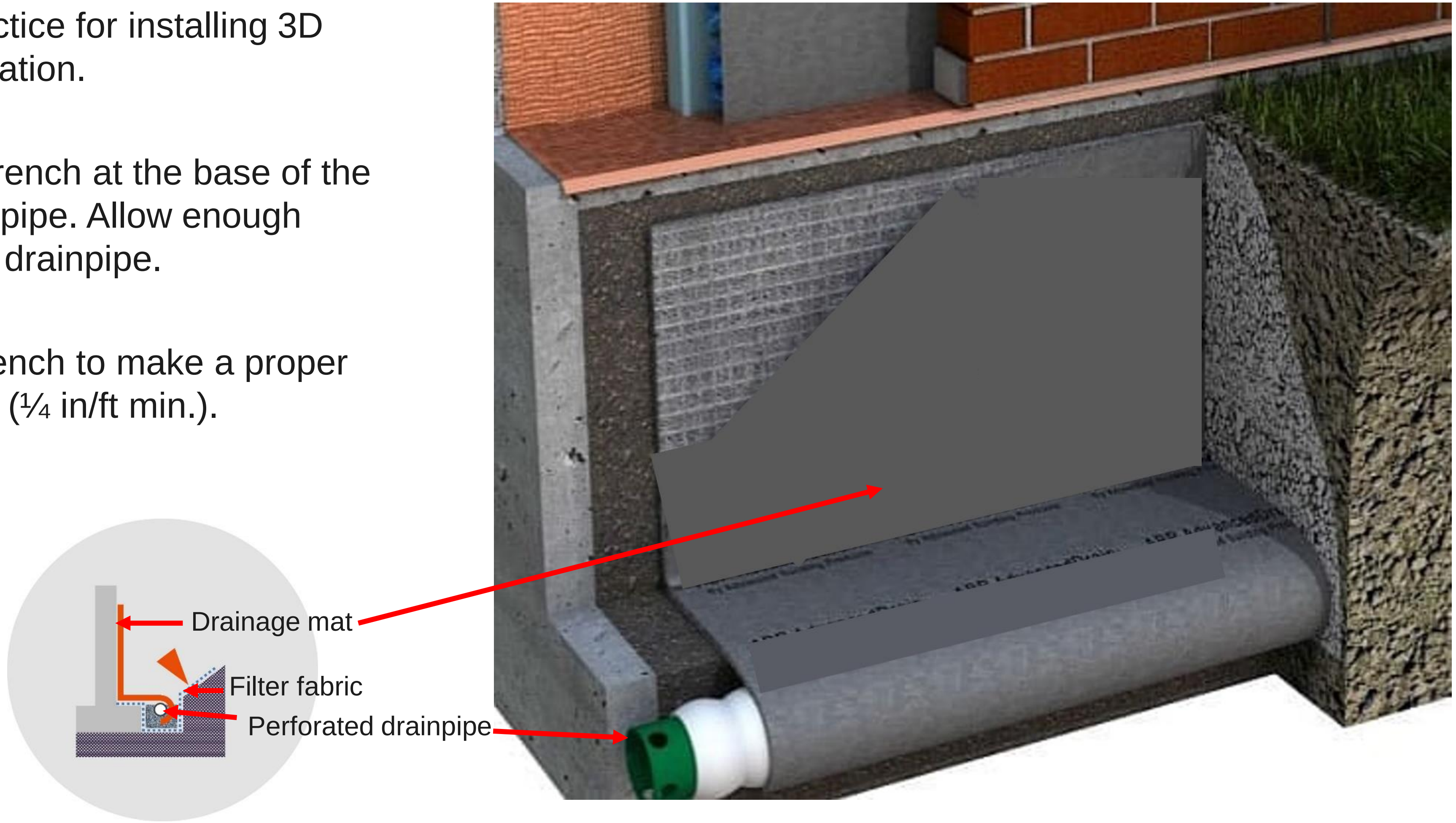


Installing Perforated Drainpipe

This is considered best practice for installing 3D drainage mats in this application.

First, lay filter fabric in the trench at the base of the wall for the perforated drainpipe. Allow enough length to fold back over the drainpipe.

Then, place gravel in the trench to make a proper drainage slope for the pipe. (¼ in/ft min.).



Installing Vertical Drain Panels on Basement Walls

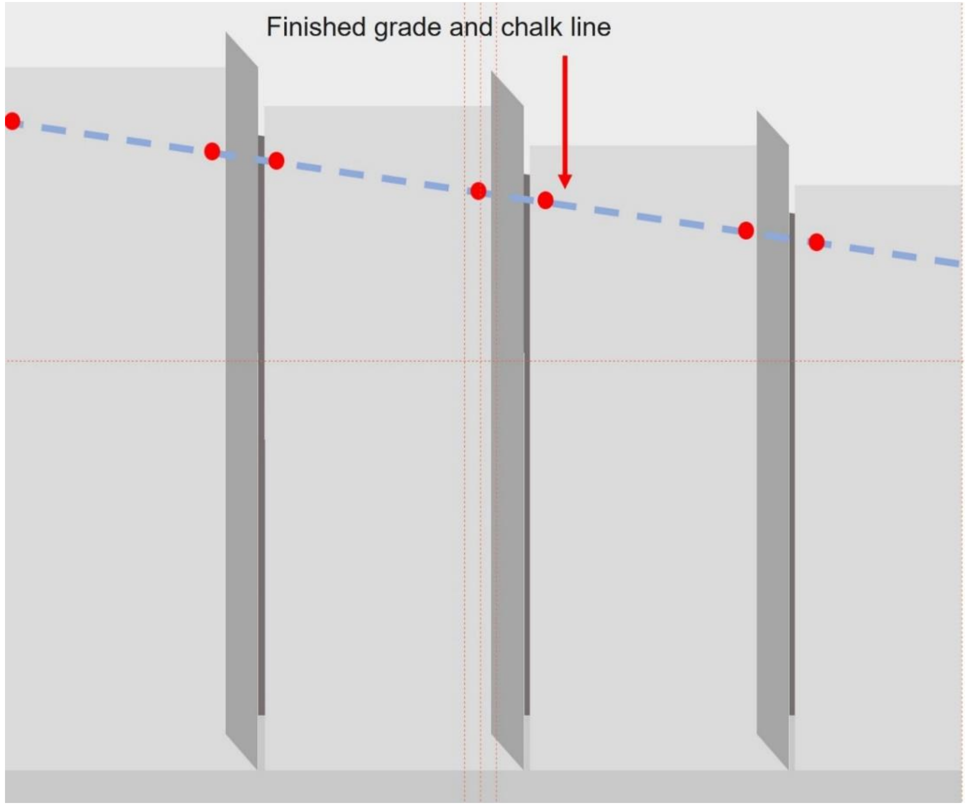
Clean the footing area and remove any remaining debris at the base of the wall.

Install water-/damp-proofing. Verify that it is installed according to the manufacturer's guidelines before installing drain panels.

Determine where the finished grade will be and snap a chalk line along that level for the entire length of the perimeter wall.

Unroll the drainage mat material, cut it (allow sufficient length to wrap the footing drainpipe as per the previous slide), and place it with the filter fabric toward the soil side.

Attach the panels to the chalk line with power-actuated fasteners to hold the panel in place.



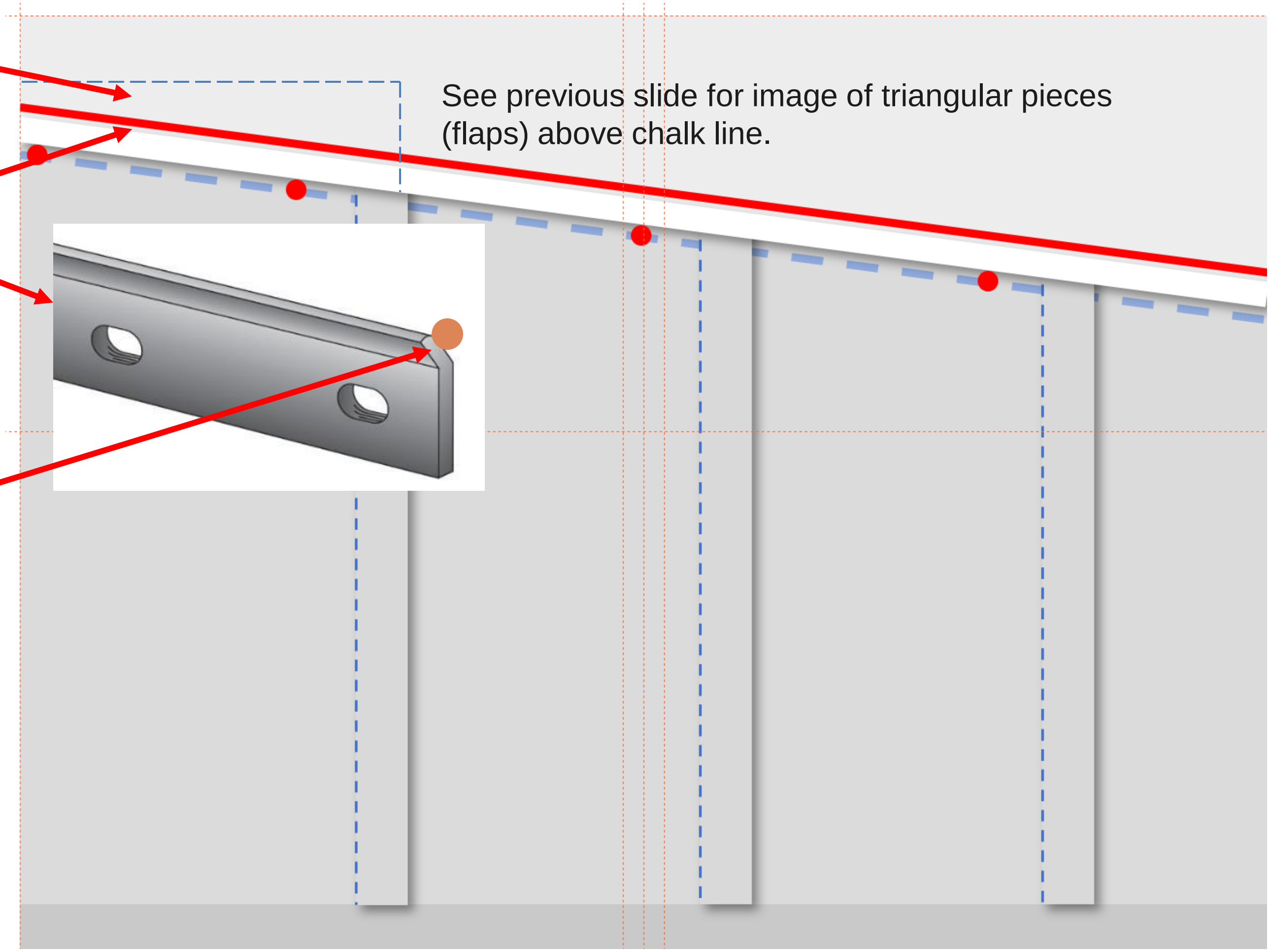
Installing Vertical Drain Panels

Fold drainage mat flaps over and tack in place with construction adhesive.

Install the termination bar with sealant lip along the chalk (grade) line.

Trim excess drainage mat above termination bar.

Apply sealant to the termination bar lip.



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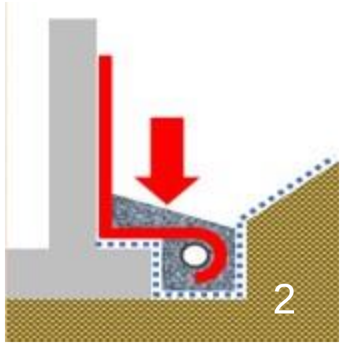
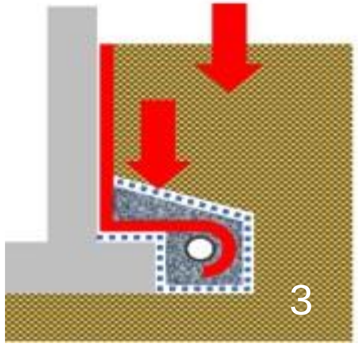
Installing Vertical Drain Panels: Final Steps

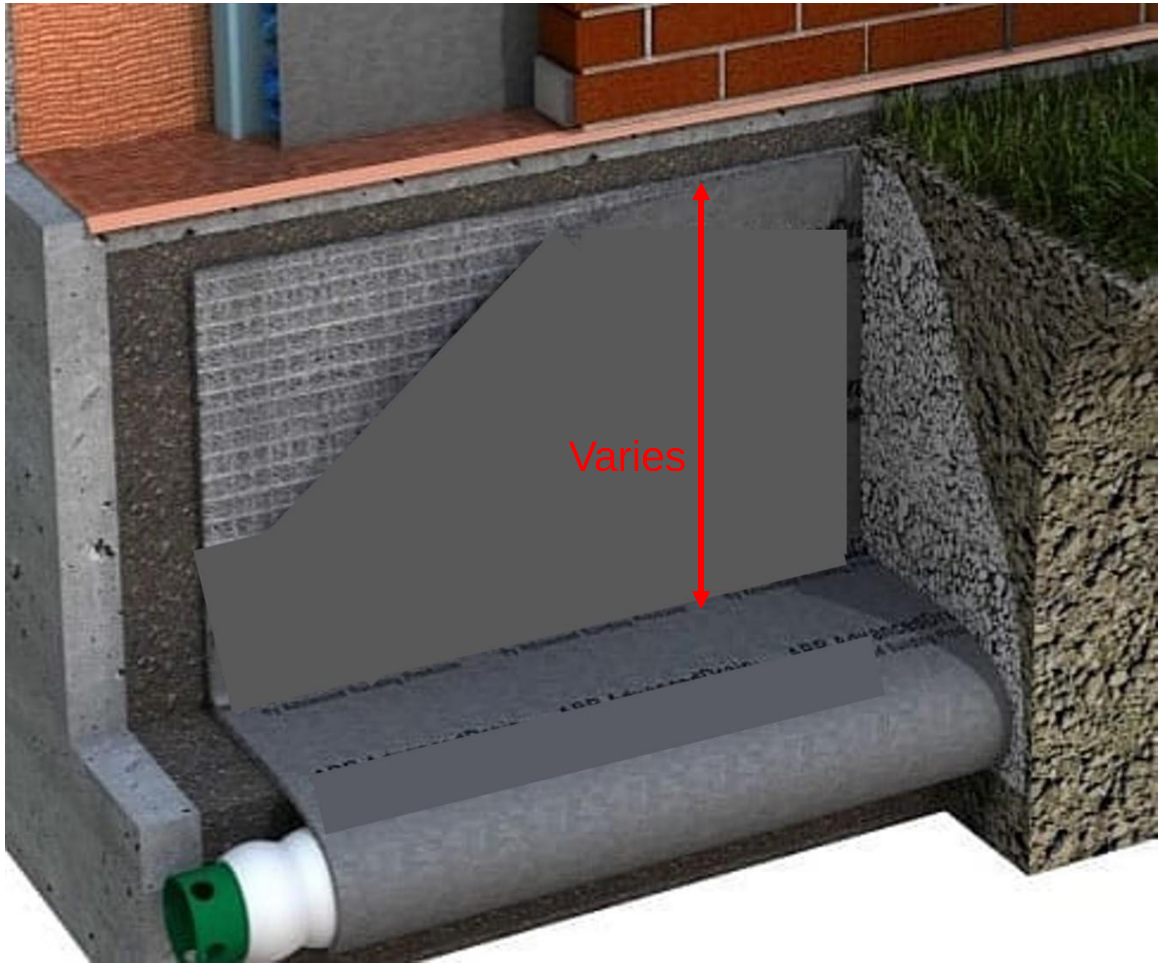
1. When drain panels are installed, wrap the extra length around the drainpipe at the base of the wall. Note that the full height of the drainage panels will vary with the height of the final grade.

2. Place gravel on top of the drainpipe and drainage mat.

3. Fold filter fabric back over the gravel and then backfill with soil.

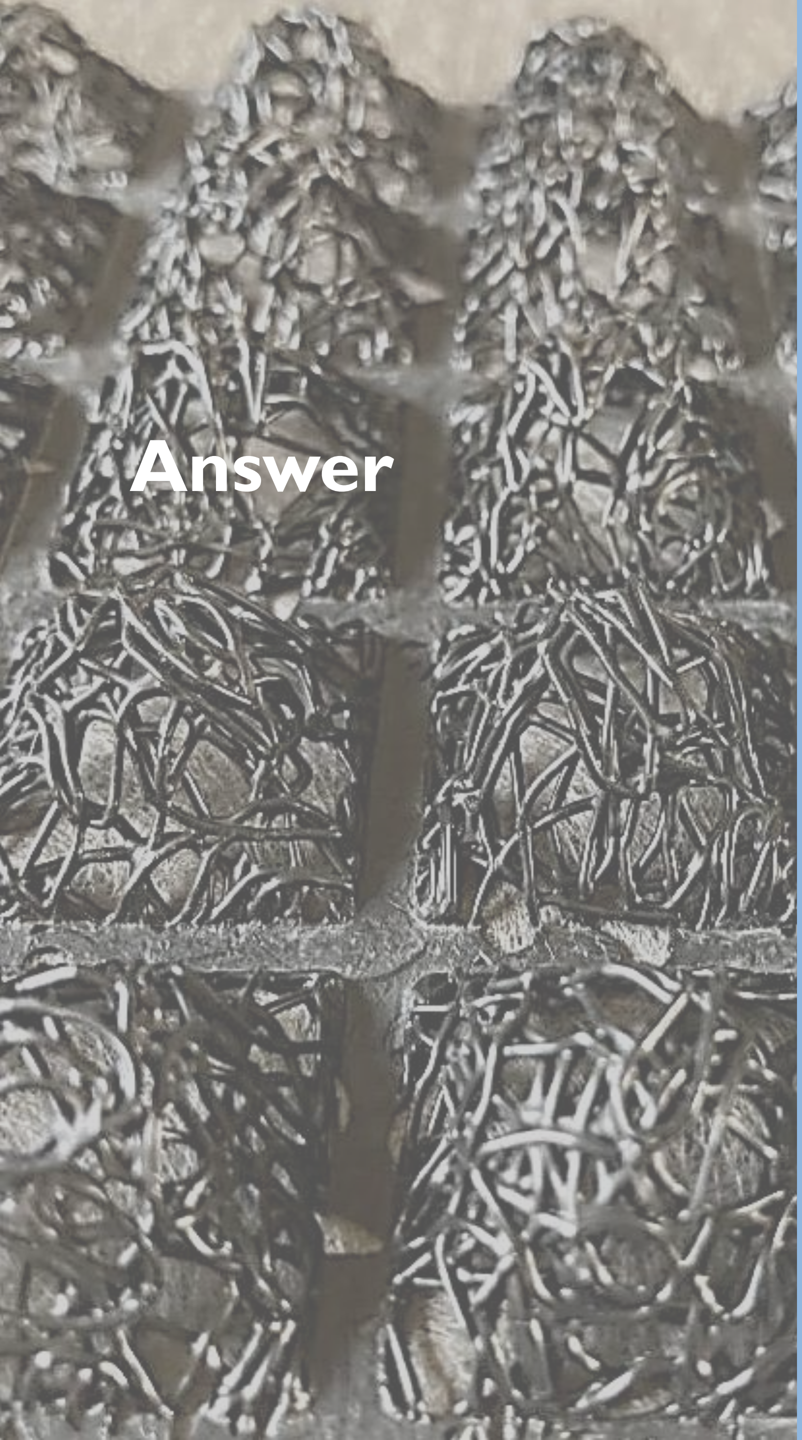






Review Question

Describe the method for installing an effective crawl space overlay to prevent radon entry into a house.



Answer

For projects with a crawl space with exposed soil, begin by installing a drainage mat over the entire area to create a horizontal vent space.

Follow this by sealing off the crawl space with a nonpermeable vapor barrier, also over the entire area.

RADON CONTROL IN BUILDING CODES AND STANDARDS

Radon Control in Building Codes

This section highlights some of the radon control requirements and methodologies noted in various applicable building and fire codes and standards.

It is important to note that these are highlights and excerpts only. Designers must consult the entire document for the complete requirements.

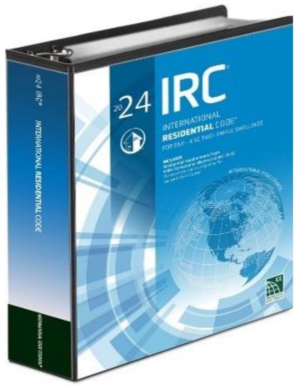
A number of the highlighted codes are international codes. These are model codes that may or may not be adopted or adapted in local jurisdictions. The *International Building Code*®, for example, is adopted in every state, the District of Columbia, Guam, Northern Marianas Islands, New York City, the US Virgin Islands, and Puerto Rico.

Once again, designers should consult the local authority having jurisdiction (AHJ) to verify which codes apply and which version is in use. International codes are generally updated every three years, but local adoption usually lags by various time lengths.

Radon Control in Building Codes

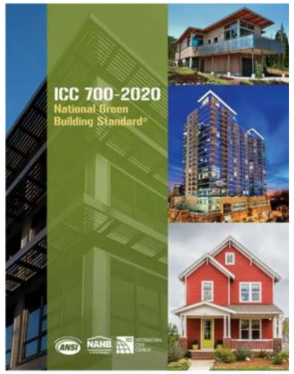
Radon and radon interception are referenced in numerous building codes and standards, including these International Code Council® documents (links on resource slide):

The *2024 International Residential Code*® (IRC®) Appendix BE Radon Control Methods contains an extensive list of US counties with high radon levels (zone 1) and control requirements and approaches, including subslab depressurization methods.



The *2024 International Green Construction Code*® (IgCC®) sections 801.8 (8.8) and 1001.8 (10.8) outline soil-gas control requirements.

The *2020 National Green Building Standard*™ (ICC 700) section 1205.9 requires the installation of a radon control system in zone 1.



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2024 IRC Appendix BE Radon Control Methods: Excerpts

Appendix BE applies to jurisdictions where radon-resistant construction is required. It defines subslab and submembrane depressurization systems as follows:

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

A subslab depressurization system (active) is designed to lower subslab air pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the slab.

A subslab depressurization system (passive) is designed to 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.

The following few slides provide detailed information on how these systems should be designed. Designers can also use codes and standards as design guidelines to ensure their designs are safe and compliant.

2024 IRC Appendix BE Radon Control Methods: Excerpts

BE 103.5 Passive Submembrane Depressurization System: In buildings with crawl space foundations, the following components shall be installed during construction. Exception: Buildings in which an approved mechanical crawl space ventilation system or other equivalent system is installed.

BE 103.5.1 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.

BE 103.5.2 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 not less than 12 inches (305 mm) at joints and shall extend to all foundation walls enclosing the crawl space area.

BE 103.5.3 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 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.

2024 IRC Appendix BE Radon Control Methods: Excerpts

BE 103.6 Passive Subslab Depressurization System: In basement or slab-on-grade buildings, the following components shall be installed during construction.

BE 103.6.1 Vent Pipe: A minimum 3-inch-diameter (76 mm) ABS, PVC, or equivalent gastight 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 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 vent 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) away from any window or other opening in adjoining or adjacent buildings.

BE103.6.2 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 pipe shall terminate separately above the roof.

2024 IRC Appendix BE Radon Control Methods: Excerpts

BE 103.7 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.

BE 103.8 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 rooftop electrical supply is provided for future use.

BE 103.9 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.”

BE 103.10 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.

BE 103.11 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.

NFPA Radon Control

NFPA 5000, *2024 Building Construction and Safety Code*® section 49.2.5 is an extensive section with a comprehensive range of radon control requirements. Similar to other codes, it requires submembrane and subslab passive systems as follows:

49.2.5.3.4 Passive Submembrane Depressurization System: In buildings with crawl space foundations, the following components of a passive submembrane depressurization system shall be installed in accordance with figure 49.2.5.3.4 unless an approved mechanical crawl space ventilation system or other equivalent system is installed.

49.2.5.3.5 Passive Subslab Depressurization System: In basement or slab-on-ground buildings, the components of a passive subslab depressurization system, as specified in 49.2.5.3.5.1 through 49.2.5.3.5.8, shall be installed during construction in accordance with figure 49.2.5.3.5.

Designers should consult the document to see the entire requirements.

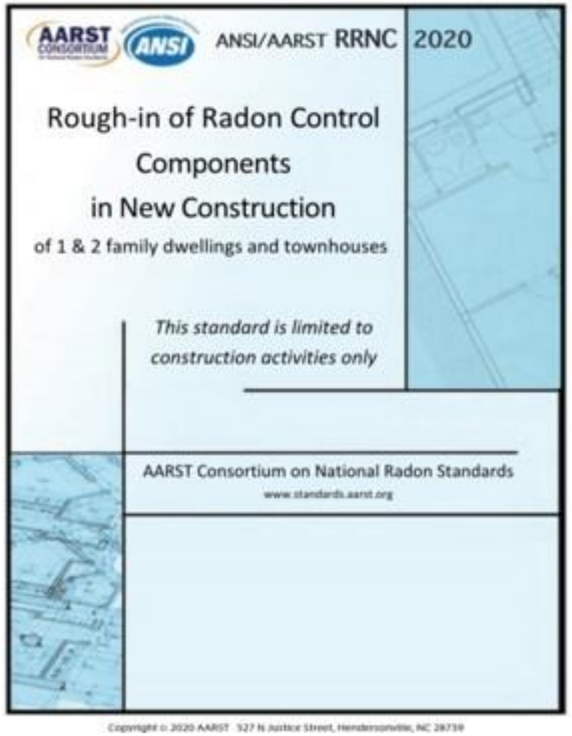
Radon Control in Building Standards

There are also several standards related to radon control. The AARST/ANSI (Indoor Environments Association™/American National Standards Institute) provides various radon control standards, including "**Rough-in of Radon Control Components in New Construction of 1 and 2 Family Dwellings and Townhouses**."

Purpose:

1. To regulate the design and construction of buildings to facilitate the removal of radon gas
2. To provide minimum requirements for the rough-in of radon control system components in new dwelling units under construction
3. To provide requirements for adoption by states and local jurisdictions

This standard's requirements address only soil-borne radon. They do not address radon from other sources, such as water and building materials.

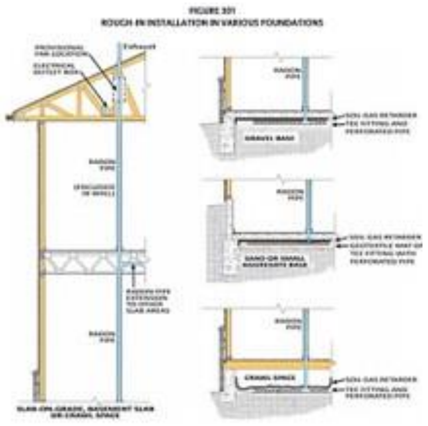


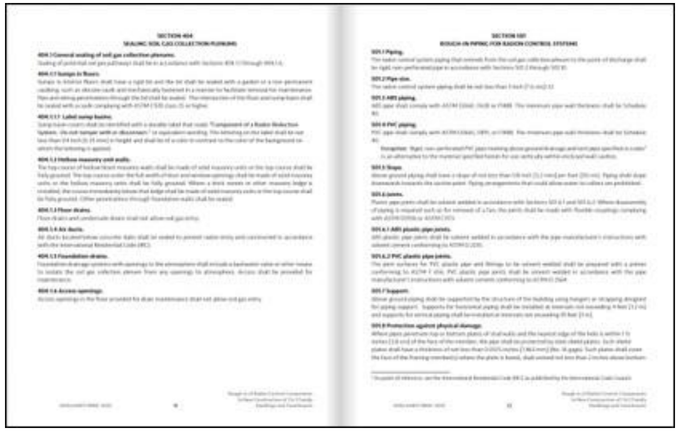
Radon Control in Building Standards

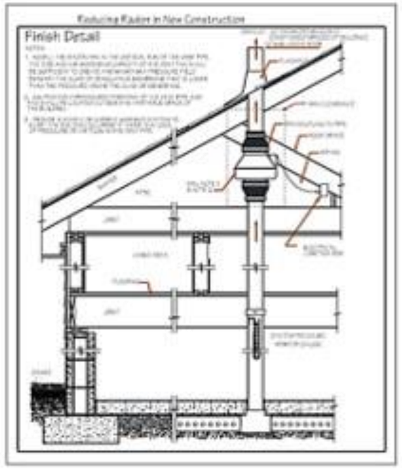
The standards supply detailed diagrams along with comprehensive text descriptions and explanations, both of which can be used as design aids and to clarify standard requirements and code language.

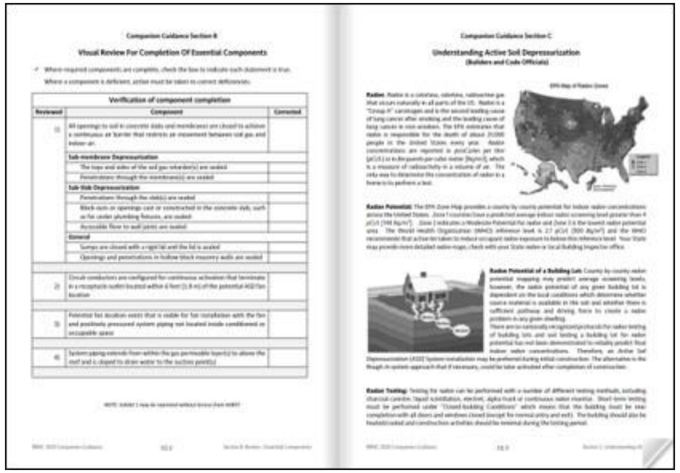
They also contain numerous definitions, clarifications, and requirements of radon interception system components in several contexts, references to all relevant standards, and links to further information.

Standards are far more comprehensive than codes.







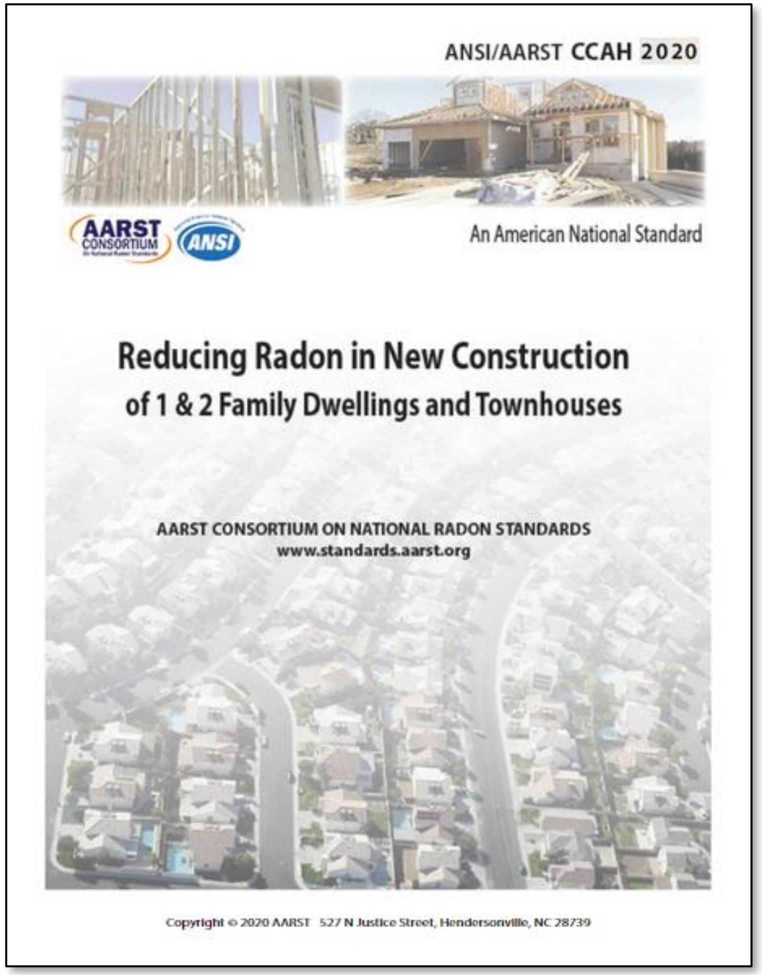


Radon Control in Building Standards

CCAH (Construction Code Applicable to Homes), "Reducing Radon in New Construction of 1 & 2 Family Dwellings and Townhouses"

Purpose:

1. To specify radon control methods and techniques for use in dwelling units to reduce indoor radon concentrations to below the national action level (NAL) of 4.0 pCi/L (150 Bq/m^3)
2. To provide minimum requirements for the rough-in of radon control system components in new dwelling units under construction and activation of the radon control systems, if required
3. To provide a model set of requirements for adoption by states and local jurisdictions
4. To provide a means for authorized personnel to inspect and evaluate rough-in components of radon control systems and activated radon control systems in new construction



Radon Control in Building Standards

While the standards share some basic information about radon and radon interception, each one also adds further insights and information.

In this case, section 801.1 improves upon the practical application of initial radon testing after a home is constructed.

Appendix B defines qualities associated with acceptable certification programs. The effective date for compliance with this standard was December 1, 2023.

There is also a valuable construction checklist.

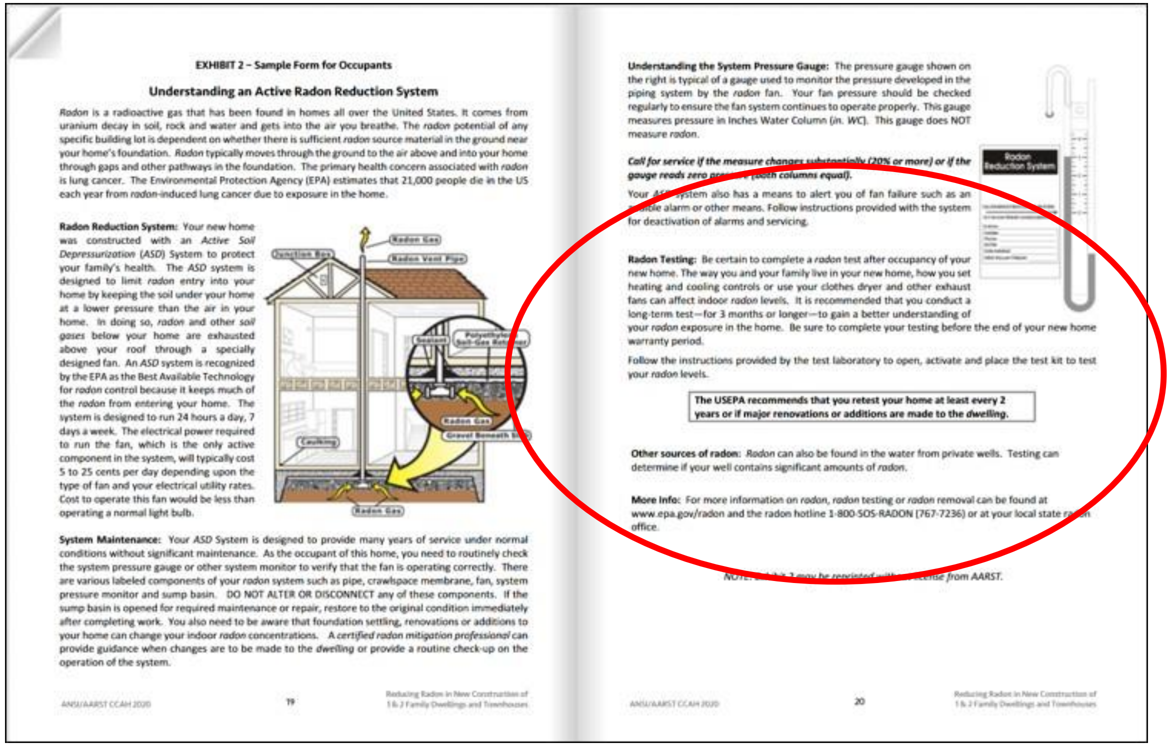


EXHIBIT 2 – Sample Form for Occupants

Understanding an Active Radon Reduction System

Radon is a radioactive gas that has been found in homes all over the United States. It comes from uranium decay in soil, rock and water and gets into the air you breathe. The *radon* potential of any specific building lot is dependent on whether there is sufficient *radon* source material in the ground near your home's foundation. *Radon* typically moves through the ground to the air above and into your home through gaps and other pathways in the foundation. The primary health concern associated with *radon* is lung cancer. The Environmental Protection Agency (EPA) estimates that 21,000 people die in the US each year from *radon*-induced lung cancer due to exposure in the home.

Radon Reduction System: Your new home was constructed with an *Active Soil Depressurization* (*ASD*) System to protect your family's health. The *ASD* system is designed to limit *radon* entry into your home by keeping the soil under your home at a lower pressure than the air in your home. In doing so, *radon* and other *soil gases* below your home are exhausted above your roof through a specially designed fan. An *ASD* system is recognized by the EPA as the Best Available Technology for *radon* control because it keeps much of the *radon* from entering your home. The system is designed to run 24 hours a day, 7 days a week. The electrical power required to run the fan, which is the only active component in the system, will typically cost 5 to 25 cents per day depending upon the type of fan and your electrical utility rates. Cost to operate this fan would be less than operating a normal light bulb.

System Maintenance: Your *ASD* System is designed to provide many years of service under normal conditions without significant maintenance. As the occupant of this home, you need to routinely check the system pressure gauge or other system monitor to verify that the fan is operating correctly. There are various labeled components of your *radon* system such as pipe, crawlspace membrane, fan, system pressure monitor and sump basin. DO NOT ALTER OR DISCONNECT any of these components. If the sump basin is opened for required maintenance or repair, restore to the original condition immediately after completing work. You also need to be aware that foundation settling, renovations or additions to your home can change your indoor *radon* concentrations. A *certified radon mitigation professional* can provide guidance when changes are to be made to the *dwelling* or provide a routine check-up on the operation of the system.

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Understanding the System Pressure Gauge: The pressure gauge shown on the right is typical of a gauge used to monitor the pressure developed in the piping system by the *radon* fan. Your fan pressure should be checked regularly to ensure the fan system continues to operate properly. This gauge measures pressure in Inches Water Column (*in. WC*). This gauge does NOT measure *radon*.

Call for service if the measure changes substantially (20% or more) or if the gauge reads zero pressure (both columns equal).

Your ASD system also has a means to alert you of fan failure such as an audible alarm or other means. Follow instructions provided with the system for deactivation of alarms and servicing.

Radon Testing: Be certain to complete a *radon* test after occupancy of your new home. The way you and your family live in your new home, how you set heating and cooling controls or use your clothes dryer and other exhaust fans can affect indoor *radon* levels. It is recommended that you conduct a long-term test—for 3 months or longer—to gain a better understanding of your *radon* exposure in the home. Be sure to complete your testing before the end of your new home warranty period.

Follow the instructions provided by the test laboratory to open, activate and place the test kit to test your *radon* levels.

The USEPA recommends that you retest your home at least every 2 years or if major renovations or additions are made to the dwelling.

Other sources of radon: *Radon* can also be found in the water from private wells. Testing can determine if your well contains significant amounts of *radon*.

More Info: For more information on *radon*, *radon* testing or *radon* removal can be found at www.epa.gov/radon and the radon hotline 1-800-SOS-RADON (767-7236) or at your local state radon office.

NOTE: Exhibit 2 may be reprinted without license from AARST.

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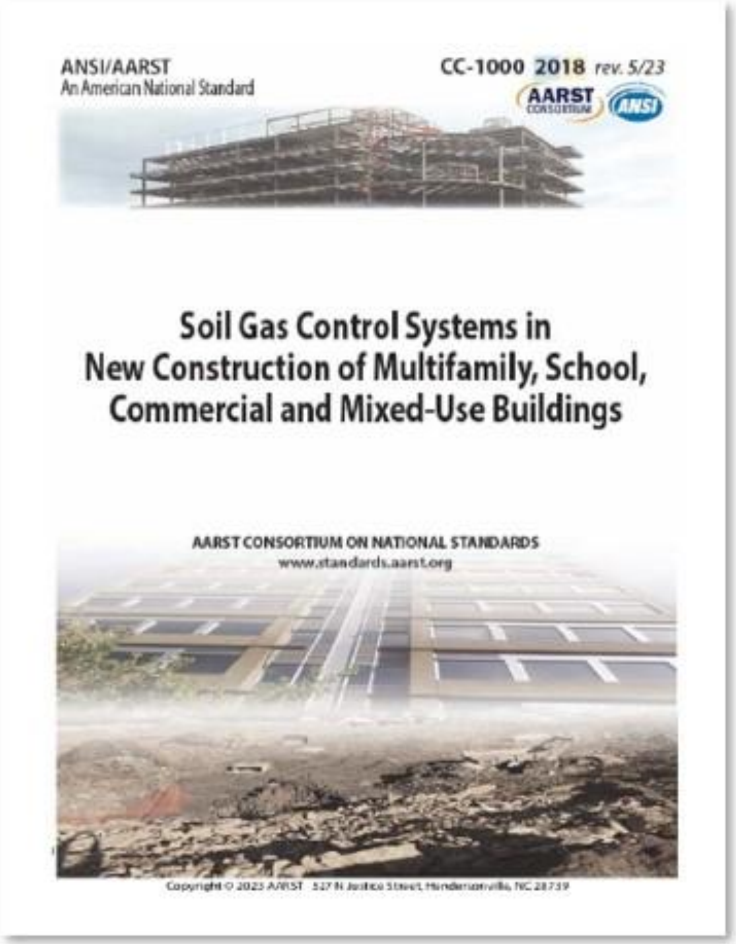
Radon Control in Building Standards

CC-1000 (Commercial Construction), "Soil Gas Control Systems in New Construction of Multifamily, School, Commercial, and Mixed-Use Buildings"

As the title suggests, this standard applies to nonresidential building types because construction methods, especially foundation types, differ substantially from those of houses. Building mechanical systems, building sizes, etc. and occupancy patterns are also very different.

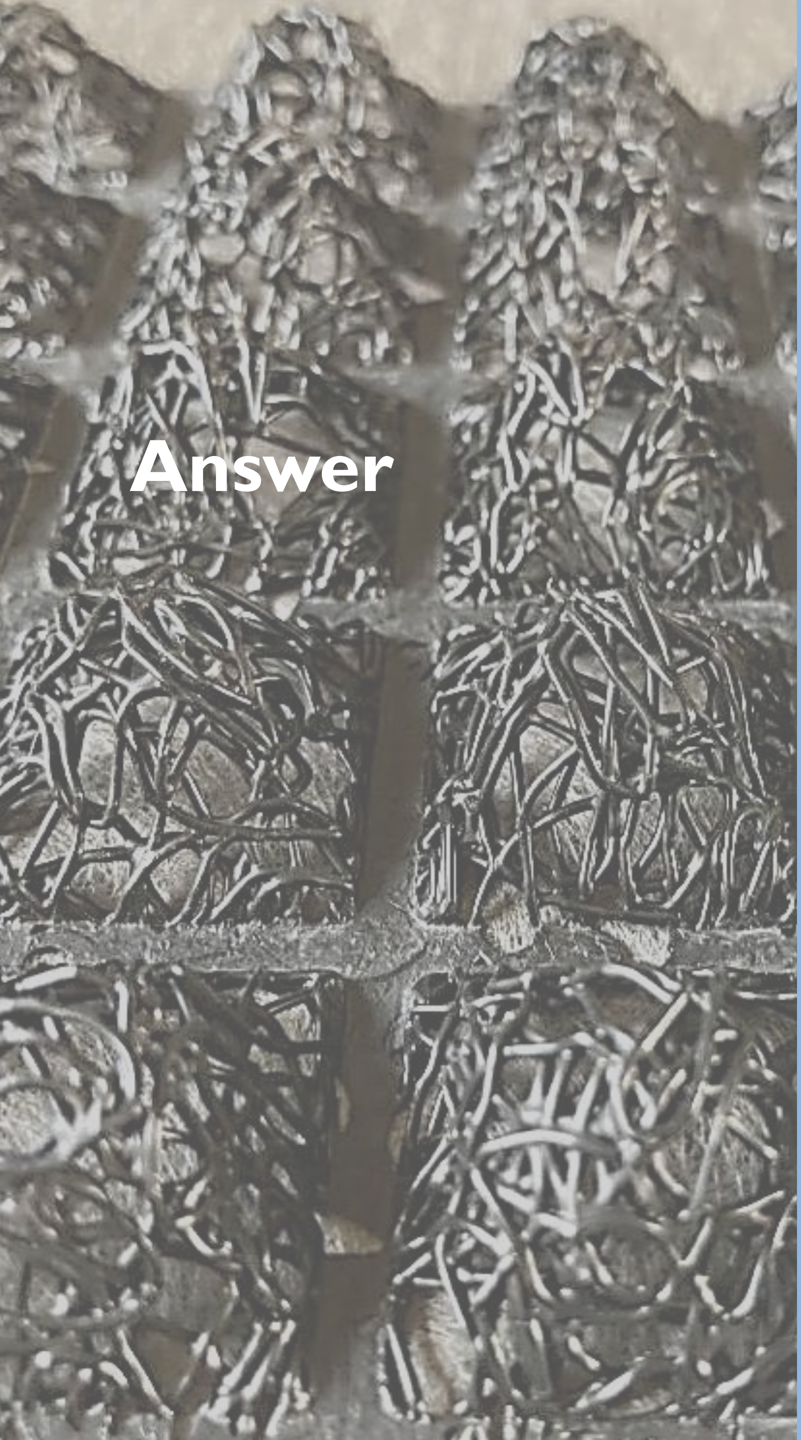
It also contains a section entitled "Companion Guidance." Although this 12-page section is not technically part of the standard, it provides considerable advice on how to interpret the requirements in certain specific situations and how to ensure compliance with the standards. This advice includes step-by-step procedures for designers and installers.



Review Question

How do you create an integrated interior/exterior interception system?

Answer



When you combine the subslab grid with a turned-up strip of vent mat, a subsurface wall drain, and subsurface wall encapsulation, you create an integrated exterior/interior system that captures radon from both the wall and the earth.

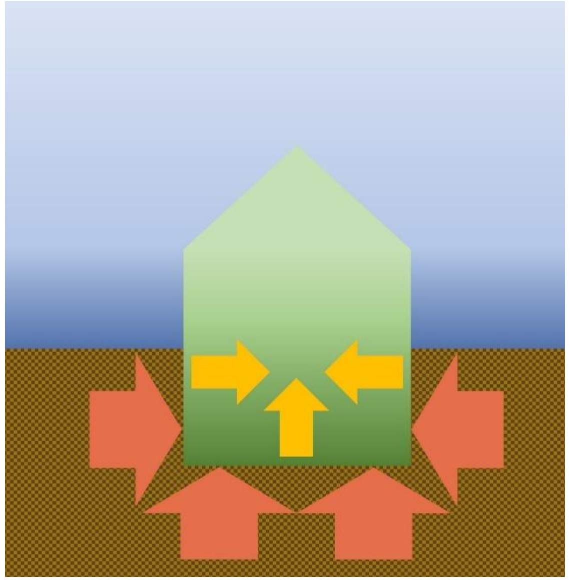
SUMMARY AND RESOURCES

Summary

Radon is a colorless, odorless, radioactive gas that comes from the natural decay of uranium. It is a Class A carcinogen and the leading cause of death for nonsmokers. If not intercepted properly, it can seep undetected into the home through subgrade structures. If it does enter the house, it can build up in concentration, be inhaled, and lead to cancer and potential death for inhabitants.

It can enter a home from the ground and through basements and crawl spaces by various methods. Hydrostatic pressure and source accumulation in the soil can push the radon gas toward the building structure. Negative pressure or suction and stack effect can pull the radon gas into the interior of the building through the building envelope. Negative pressures often result from human activities, such as the use of interior vent fans.

An effective radon interception system that can prevent the entry of this gas into the home is typically composed of a grid vent mat laid out on the soil, a drainage mat overlay that provides complete coverage, a vapor barrier, and a riser pipe with or without a fan that extends above the roof, as well as aggregate under the concrete slab.



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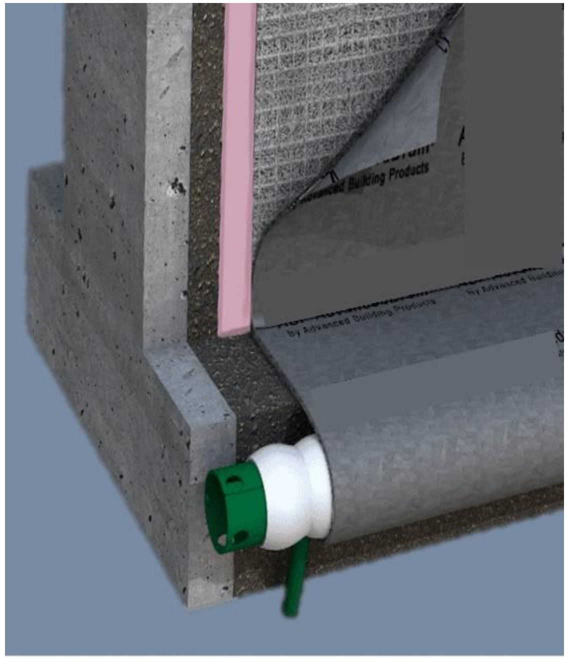
Summary

There are three categories of interception systems.

A subslab system gathers and traps radon gas under the basement concrete slab and moves the gas through vent mats and drainage mats toward a riser pipe, where it rises through the building to above the roof and dissipates into the atmosphere.

A crawl space overlay system gathers and traps radon gas from the soil below the vapor barrier in crawl spaces. It then moves the gas through a mat system to the riser pipe, where it is taken to outside air and then dissipates.

A subsurface wall encapsulation system is actually a subsystem of a subslab system. This system uses drainage mats on the exterior of the basement walls to create an air gap on the outside of the foundation wall. This gap relieves hydrostatic pressure and intercepts the radon gas before it can enter the building.

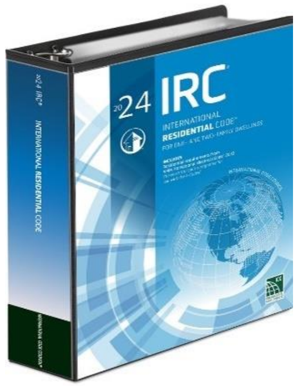


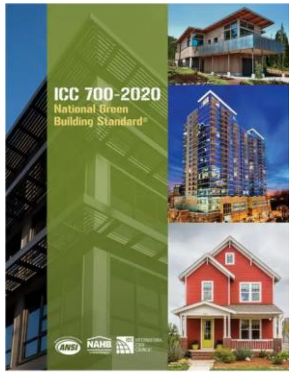
Summary

These systems are mandatory where soil readings show a radon level of > 4 pCi/L (often referred to as zone 1 in codes such as the IRC, NFPA, and IgCC). It is considered best practice to install them where readings are between > 2 pCi/L and < 4 pCi/L because there is still a distinct possibility of cancer at those levels.

A number of building codes require radon control, and its methodology is carefully detailed in a range of standards that inform those codes. The codes and the more comprehensive standards can be used as design aids.

When designers fully understand the dangers of radon, how it moves through soil, rock, and water, the materials and methods with which they can create effective radon interception systems, and the codes and standards that regulate those systems, they can create environments for residents and building occupants that are safe from the threat of radon.





Resources

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