Under Slab Radon Gas Mitigation

What is Radon?

Radon is an odorless, colorless, tasteless and radioactive noble gas. It is formed by the breakdown of uranium which can be naturally found in soil, rock and groundwater. As radon escapes from the ground it is absorbed into the air. Under typical exterior conditions, the radon concentration gets diluted and does not pose a concern. The issue manifests when radon enters an enclosed space, such as a basement of a house, and is able to accumulate to high levels. Radon can further break down to form radioactive particles called progeny that can further contaminate the indoor air.

What Is The Risk?

Radon gas and radon progeny can be inhaled into the lungs where they damage lung cells. As lung cells reproduce, they can result in cancerous cells. The risk of lung cancer from radon depends on the concentration of radon in the interior air and length of time exposed to radon. The CDC states that radon is the second leading cause of lung cancer after cigarette smoking while the National Cancer Institute of Canada estimated that 10% of lung cancer related deaths are caused by radon.

How It Enters Buildings?

Radon gas entry into buildings can have many routes such as exposed rock or soil in crawl spaces, joints between slab and walls, floor drains and sumps, cracks in walls or slabs or around utility penetrations or hollow support columns. For the majority of the year, the air pressure inside the building is lower than that of the soil in the surrounding the foundation. This difference in pressure draws various gases from the soil into the interior. In most instances, the entry routes will be hidden by interior finishes and/or appliances making it more difficult to spot them.

Measuring Radon Levels

Radon measurement can be done using various instruments such as charcoal detectors, passive alpha-track detectors, active alpha-track detectors or electret ion chambers. Depending on the device, the length of data collection can range from a week to a year and should generally be done during the colder season to get a more accurate, worst case scenario number, since air ventilation rates drop drastically during the colder weather. Most detectors are required to be mailed to a lab for analysis.

When installing radon testing apparatus, it is important to note the location of the detectors as to avoid highly ventilated areas (such as kitchens or bathrooms), too low or too high placement in a room, not too close to exterior walls or floor drains, away from HVAC equipment and vents, not in small spaces (such as cupboards or closets). It is important to place the detectors in the lowest occupied space, such as a basement for best accuracy.

Measurement Units

After the detectors are sent to the lab, the results are reported back to the clients. In Canada, the threshold for radon levels are set to 200 Bq/m^3 (Becquerels per cubic meter, or sometimes picoCuries per liter (pCi/L), where 200 Bq/m^3 = 5.4 pCi/L). For comparison, exterior air levels of radon are generally around 0.4 pCi/L (but can be as high as 0.75 pCi/L in some instances). The US EPA (United States Environmental Protection Agency) has set an action level of 4 pCi/L for radon above which remediation measures need to be taken. For devices that also measure radon progeny radiation, the results are often reported in Working Levels (WL) where 200 Bq/m^3 = 5.4 pCi/L = 0.025 WL. The levels stated above do not imply that they are safe or acceptable but do serve as a threshold above which corrective measures are needed. The WHO (World Health Organization) recommends for all countries to adopt a reference level of 100 Bq/m^3 or 2.7 pCi/L.

Remediation

For existing houses with increased radon levels there are few preventive measures that vary in cost, complexity and effectiveness that can be incorporated either individually or in combination. The basic premise of most of the low complexity solutions is to block any pathway for the radon gas to enter the space (e.g. basement). Open sumps should be covered up and sealed. This can be achieved by installing an air tight cover that can either be purchased or fabricated. The requirement is for it to be removable and properly sealed. Floor drains can be outfitted with special traps that allow water to drain but prevent gas from entering the space (not a substitute for sewer backup valve).

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If the basement foundation walls are constructed with CMU, fill the voids at the top of the block should be sealed with mortar or spray foam. Any exposed soil should be covered with a membrane with sealed edges and joints. Cracks (should be enlarged to allow proper sealing), control joints, foundation and slab joins should be sealed with a combination of a backer rod and polyurethane sealant. Another method is to increase the rate of ventilation (increase in fresh air intake) through the use of an HRV (or ERV).

Active Soil Depressurization

Depending on the effectiveness of the methods mentioned above, the most effective method to fight radon ingress is by depressurizing the soil around the foundation. This method can be relatively easily incorporated into new construction or can even be done as a retrofit to basement slabs in existing houses.

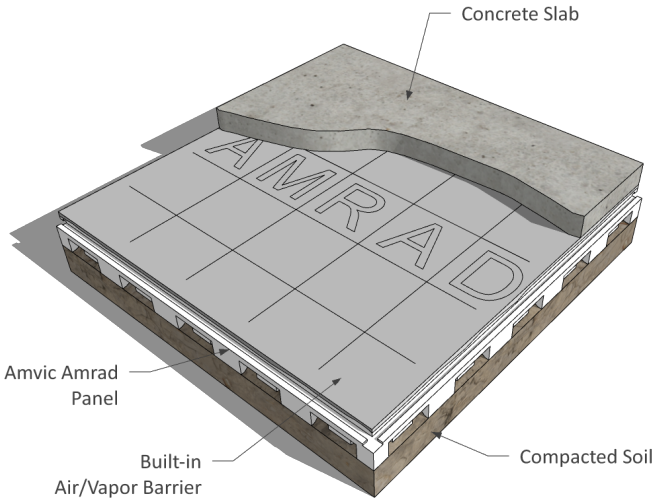
Conventional Method

The conventional method of depressurizing the slab is installing a 4” (102mm) thick layer of course gravel (granular fill) followed by a polyethylene air/vapor barrier and the concrete slab. The combination of this assembly with 4” (102mm) diameter PVC pipe which gets cast into the floor provides the base for installing a ventilation fan and exhaust which keep the slab depressurized and venting most of the radon gas to the exterior.

Amvic Method

In many instances the basement (or any space directly above the soil) greatly benefits from having insulation under the concrete slab. Amvic’s Amrad panels (patent pending) are able to offer a three in one solution by combing the insulation with venting channels and air/vapor barrier eliminating the need for granular fill and a dedicated membrane.

The unique pattern creates a void between the continuous insulation layer and the soil, allowing gas to collect there. The insulation keeps the slab warmer allowing more a comfortable interior environment for the occupants while the film acts as an air and vapor barrier, preventing any gas migration into the space.



The Amrad Adapter allows for the correct placement and installation of the 4" PVC venting pipe, ensuring that it has unimpeded access to the air channels for proper operation. The combination of all of these elements allows the Amrad system to be easily and quickly placed under a concrete slab to help mitigate subsoil gases such as radon and improve the health of the occupants.