CONCRETE SASK

TECH TIP #18

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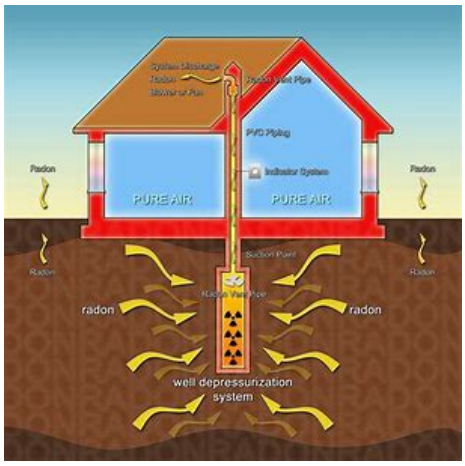
RADON RESISTANT BUIULDINGS

WHAT is radon?

Radon is a colourless, odorless radioactive gas which occurs naturally in soils in amounts dependant upon the geology of the location. The rate of movement of radon through the soil is dependant primarily upon soil permeability and degree of saturation, and differences in air pressure within the soil. Soil gas enters buildings through cracks or openings in the foundation, slab, or basement walls when the air pressure in the building is less that that of the soil.

Radon gas decays to other radioactive elements in the uranium series. Called "radon progeny", they exist as solid particles rather than as gas. These radioactive charged particles attach to particles in the air that can be inhaled. Radon can also be dissolved in ground water.



WHY is radon a concern?

Radon is categorized as a carcinogen and is one of the leading causes of lung cancer. Radon progeny that are inhaled attach to the respiratory tract and deep in the lungs. Radioactive decay of these particles in the body release energy that can cause tissue damage, which has been linked to lung cancer. Radon levels in well water, used as drinking water, should be measured and treated as needed.

When radon is released from the ground into the outdoor air, it is diluted and not a concern. Exposure to high levels of radon indoors increases the risk of developing lung cancer. While the health risk from radon exposure below the Health Canada Guideline of 200 Bq/m^3 is low, there is no safe level of radon.

Radon levels can vary from home to home depending on soil deposits, type of construction and ventilation. Testing is the only way to check the radon level. Radon test kits are available online as well as through several radon testing companies who offer professional services to building and homeowners.

The level of health risk is related to the concentration of radon in the air and duration of exposure by humans. Radon potential maps may govern radon mitigation measures during construction in some regions. There are no recognized protocols for radon testing of soil in building lots that can reliably predict indoor radon concentration. The only way to determine the concentration of radon in living space is to perform a test after the space is occupied.

Some aggregate sources used in concrete may be extracted from regions with higher radon concentration, but there is no evidence that radon is emitted from concrete containing these aggregates. Soil gas containing radon enters living space because the air pressure is less than the surrounding air and soil. Soil gas enters buildings through cracks, construction, contraction, or isolation joints, or utility openings in slabs and basement walls, and through suspended floors over crawl spaces.

HOW to construct radon resistant concrete buildings?

Solid concrete is an excellent material for use in constructing radon resistant buildings. It is an effective barrier to soil gas penetration if cracks and openings are sealed. Solid concrete slabs and basement walls are commonly used in residential buildings. Buildings resistant to radon may be easily constructed with concrete. In concrete construction, the critical factor is to eliminate all entry routes through which gases can flow from the soil into the building.

FOLLOW these guidelines to reduce radon entry

- Design to minimize utility openings. Sump openings should be sealed and vented outdoors.
- Minimize random cracking be using control and isolation joints in walls and floors. Planned joints can then by easily sealed. If done properly, any cracks which occur at the joints can be easily sealed.
- Monolithic slab foundations are an effective way to minimize radon entry. For slab on grade homes in warm climates, pour foundation and slab as a single monolithic unit.
- Use materials which will minimize concrete shrinkage and cracking (larger aggregate sizes and lower water-cementitious ratio).
- When using polyethylene film beneath the slab, place a layer of sand over the polyethylene (See Tech Tip #5 and #7).
- Remove grade stakes after striking off the slab. (If left, they can provide entryways through the slab.)
- Construct the joints to facilitate caulking.
- Cure the concrete adequately. (See Tech Tip #11).
- Caulk and seal all joints and openings in the walls or floor. (If cracks occur, they should be widened and then caulked and sealed.)

The construction of radon resistant buildings requires adhering to accepted construction practices with attention to a few additional details. In instances where high radon levels are expected, installation of a sub slab ventilation system incorporating an open graded aggregate base beneath the slab may be warranted during construction. These systems provide a positive means of evacuating soil gas from beneath the slab, diverting it directly to the outside.

References:

1. *CAN CSA A23.1-24/A23.2-24*
2. *Government of Canada Radon: Action Guidelines*
3. *Government of Saskatchewan: Radon Gas in Your Home*
4. *CIP 18, Radon Resistant Buildings, National Ready Mix Concrete Association*