# LUNG-CANCER INDUCING RADON GAS CAN BE REMOVED FROM INDOOR AIR WITH STRUCTURAL ENGINEERING

Radon is a radioactive, odourless, tasteless and invisible noble gas. People cannot therefore sense radon and it can only be detected with specialized equipment.

Radon is formed continuously in the ground when traces of uranium decay slowly into lead. Since radon is a gas it flows through porous earth and cracks in the bedrock. Radon is also found in residential buildings; the difference in outdoor versus indoor temperatures creates negative pressure which in turn sucks air from the ground under the buildings – and radon along with it – into the warm indoors.

According to **Olli Holmgren**, Inspector at the Radiation and Nuclear Safety Authority (STUK) in Finland, the biggest concentrations of radon are found near eskers, granite bedrocks and uranium mines.

– The biggest radon beds in Europe are in Finland, the Czech Republic and Portugal. The presence of radon in residential buildings is also dependent on the buildings themselves. If a house has a basement, the air beneath the house can move and negative pressure doesn't form as easily.

## CORRECT RADON MEASUREMENT

Radon is detrimental to humans. The decay products of radon enter the lungs along with the air and stick to the airways, still emitting alpha radiation. The radiation increases the risk of lung cancer, and the longer and higher the exposure, the greater the risk.

For new buildings, the upper limit of radon concentration is 200 becquerels per cubic meter. For old houses the limit is considered 400 $Bq/m^3$.

– It is important to measure the radon concentration correctly. The instrument measuring the radiation is placed on the floor of the house and kept there for two months. In some European countries, the recommended length is three months. The measurement must be taken over a long

period since the radon concentrations might change daily. It is also wise to do the procedure during winter since less radon flows indoors during the summer, Holmgren explains.

## RADON CAN BE MITIGATED WITH STRUCTURAL ENGINEERING

Harm from radon can be prevented by equipping houses with proper ventilation. Radon ventilation forms negative pressure under the tiles covering the ground. Having negative pressure there prevents radon-containing air from seeping through the cracks into the indoor air.

In new buildings, ventilation piping is built in the crawl space (the space between the floor structures of the base floor and the ground). When the entire air volume of the crawl space is replaced during every two hours, radon concentration is below the strictest requirement of 100 Bq/$m^3$. The piping can be constructed out of, for example, plastic drainpipes and sewer pipes. The drainpipes suck the air from beneath the floor and are joined with a sewer pipe which leads up in the attic, insulated. The pipe is joined to the roof fan, and the ventilation pole leads the radon-containing air outside.

In old buildings, cracks in the base floor must be sealed and the pass-throughs checked. If measurements reveal radon concentrations as too high, mitigation efforts must be started quickly. The most usual choice in renovating radon ventilation is using the suction point method with a radon pit; a hole is drilled on a slab, filled with gravel and a pipe fit into it, and the pipe led to a roof fan.

Even if a new building has radon mitigation in place, Holmgren still recommends measuring the concentrations since something can always go wrong. If the concentrations are high, it is best to install a roof fan.

– The roof fan sucks the radon-containing air out of the soil. This enhances ventilation and levels out negative pressure under the floor, which diminishes radon flows from the soil to indoors. This has been studied: the roof fan is the most efficient radon mitigation measure, Holmgren says.

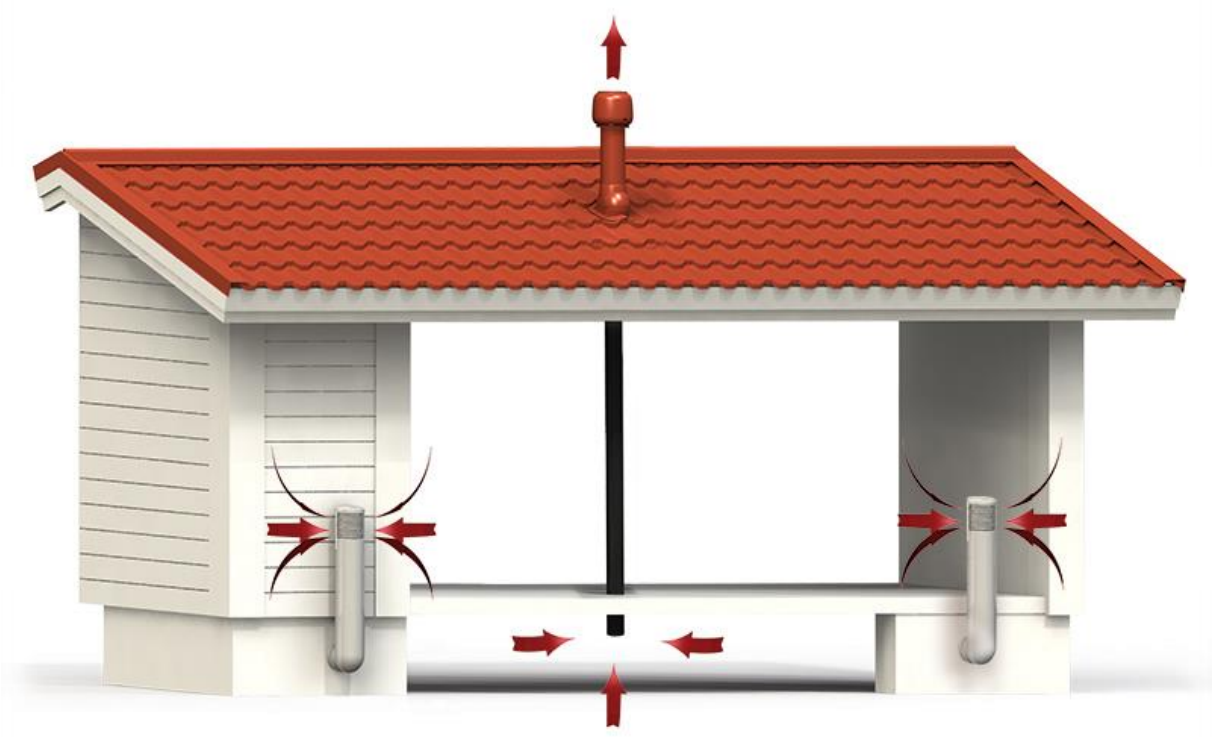
## ALTERNATIVES IN RADON MITIGATION

The SK-Tuote recommendation for radon mitigation is forced ventilation with a roof fan. The VILPE® roof fan connects to a duct from the crawl space to the roof. The fan then sucks the air from the crawl space to the roof and outside. The air removed from the crawl space also carries out other contaminants and humidity and escapes freely through the cowl. The VILPE® roof fan ensures an efficient air flow in the pipes, thus forming a good and even flush of air in the crawl space.

Radon mitigation can also be done without a fan if the building in question is on a radon-low area. In this case, instead of the VILPE® roof fan an insulated VILPE® ventilation pole with a cowl should be installed on the roof.

The pass-through should be chosen according to the roofing material. The VILPE® Steel pass-through is suitable for all profiled steel roofing, the Classic pass-through for standing seam steel roofing (or, if retrofitted, also felt roofing), the VILPE® Tile pass-through for concrete tile roofing and the VILPE® Felt pass-through for new felt roofing. Depending on the roofing, the complete pass-through set includes the pass-through piece, the underlay seal, the rubber seal, sealing compound, screws, screwdriver and instructions. The VILPE® pass-through must be installed according to the Installation, Usage and Maintenance Instructions, as close the roof as possible. The pipe is insulated if necessary, with humidity-proof material. To make the result unnoticeable, the colour of the materials should be chosen according to the colour of the roof.

In Finland, radon is studied by the Radiation and Nuclear Safety Authority (STUK). National studies in the Great Britain are conducted by the BRE Group and in the Czech Republic by the Czech Technical University. Europe-wide study has been done by RADPAR, an EU project, listing different mitigation methods and statistics from European countries. There haven't been global studies on radon concentrations.



Sources:

Holmgren, Olli & Hannu Arvela (2011). RADPAR. Assessment of radon control technologies. Deliverable 13/1: Assessment of current techniques used for reduction of indoor radon concentration in existing and new houses

Radiation and Nuclear Safety Authority (STUK) – Finland.

STUK: Interview with Olli Holmgren, Inspector at STUK

Interview with Veli-Pekka Lahti, Research and Development Director at SK Tuote Oy