European Radon Solutions Database

Prepared by

: ERRICCA 2 *European Radon Research and Industry Collaboration Concerted Action*

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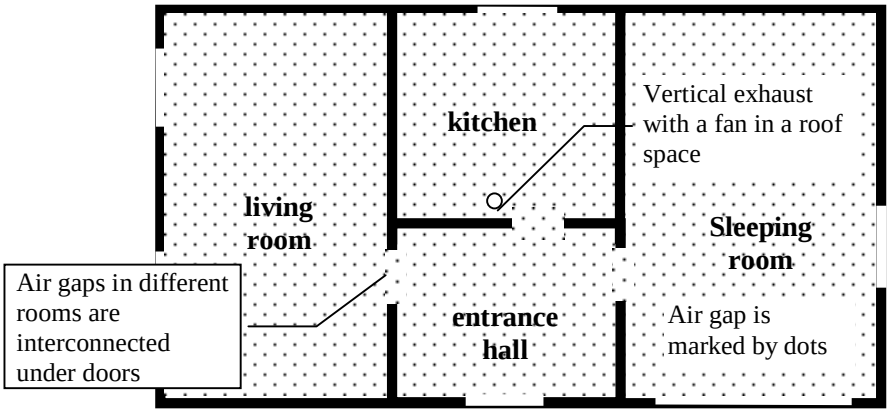
Existing Buildings

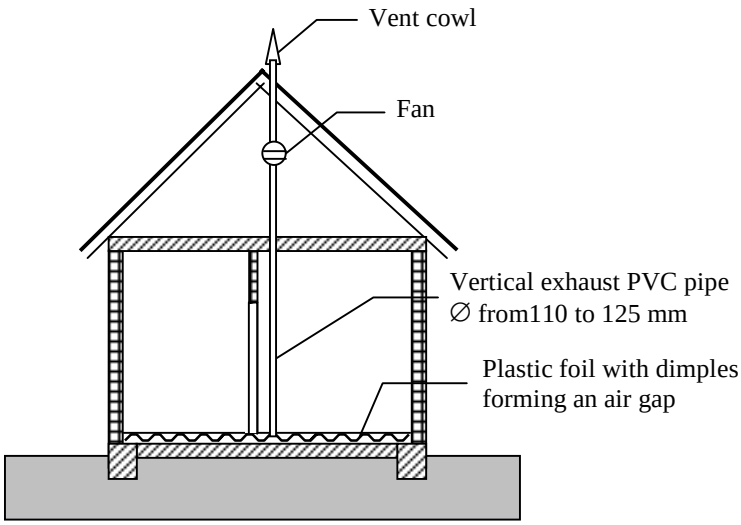
Generic Solution

Sheet N° CZ/GS/08

Type	**RECONSTRUCTION OF FLOORS AND/OR BASEMENT WALLS BASED ON INSTALLATION OF VENTILATED AIR GAPS**
Country	**Czech Republic**

Illustration





Description

This solution is designed to lower the air pressure in the air gap and at the same time to increase the airtightness of the floors. After removing of existing floor finishing, the floor and wall surfaces, which are in contact with soil, are covered with plastic foil with dimples. This foil forms an air gap and serves as radon-proof insulation. The air gap is connected usually by a vertical exhaust pipe to a fan that draws air from the gap. Finally new surface finishing is installed. The advantage of this solution is that the vertical exhaust pipe runs through the heated part of the house and thus it works partly as a passive system creating a slight underpressure in the subsoil without the help of a fan.

Radon-proof insulation

Plastic foils with dimples, that form an air gap, serve at the same time as radon-proof insulation. It means that these foils must be designed and applied in the same way as radon-proof insulation. When the thickness of the foil is calculated, radon concentration in the soil C_s is replaced by radon concentration within the air gap C_{ag}, which can be calculated according to Czech Standard CSN 730601 from the known radon supply rate into the house J:

$$C_{ag} = \frac{J}{n_{ag}.V_{ag}} \qquad (\text{Bq/m}^3)$$

where J is the radon supply rate into the house (Bq/h), n_{ag} is the air exchange rate in the air gap (h^{-1}) and V_{ag} is the air volume of the air gap (m^3).

Air gaps should be ventilated with a slight underpressure.

Fans

The most commonly used types of fans are small axial fans or in-line paddle-wheel fans with airtight casing or roof paddle-wheel fans. These fans should have a flow rate from 20 m^3/h to 100 m^3/h at a pressure difference from 200 Pa to 30 Pa and power consumption between 15 and 40 W. The power of fan is controlled by means of voltage regulator. To minimise negative effects (reduced underfloor temperatures and increased air exchange rate) the fan should be switched to intermittent mode with the frequency of operating periods depending on soil permeability, floor tightness and radon concentration in the soil.

Fans should be resistant to weathering and to moisture condensation inside pipes. To avoid disturbing noise effects the fan should be installed away from the occupied rooms.

Pipework

Standard PVC-U pipes with the diameter from 110 mm to 125 mm can be used for vertical exhaust. To reduce visual impact vertical pipe can be inserted inside a free flue or can be boxed-in in the corner of a room. In flueways only flexible PVC, aluminium or rustless pipes are used. Due to the condensation inside pipes all pipes should be installed in a slight slope towards the air gap so that water can escape (discharge) in the gap. Exhaust outlet should be located well away from windows, doors and other vents.

All pipe penetrations through the plastic foil should be carefully sealed by gun applied flexible acrylic or low modulus silicone sealants or by expanding polyurethane sealants.

When to use the system

This form of radon mitigation is convenient for houses with floors and basement walls in bad condition, where their reconstruction is necessary not only from radon point of view. The advantage of this solution is that it ensures perfect pressure distribution within the air gap, at the same time solves damp and radon problems and provides houses with new floor and wall finishing. The system can be used in houses built on soils with very low permeability.

Pre-installation Diagnosis

To find source rooms (radon entry routes) and to prepare information for the effective design of the remedial measure, these parameters must be measured:

- Radon concentration in all habitable rooms performed at least by one weak measurements under conservative conditions (lower ventilation and good condition for radon entry into the house),
- Radon supply rate into all habitable rooms,
- Radon concentration in the soil gas around the house (the measuring depth is 0,8 m),
- Permeability of the soil around the house.

Typical radon reductions achieved

The effectiveness of such systems varies between 70 and 90 %, which means that indoor radon concentration decreases to 30 % up to 10 % of the initial values. The effectiveness is mainly influenced by the fan power and by the air tightness of the new radon-proof insulation.

Limitations

Among the disadvantages of this solution belong higher labour and time consumption, obstructions in the living space of the house and high installation costs. The system is not suitable for houses, where the obstructions in the living space are not acceptable.

Common failure modes

The system can fail only in these situations:

- fan with inadequate pressure/flow rate characteristic is used,
- fan is damaged by condensed water,
- house owner switches off the system.

System enhancements

The intermittent operation of fans is recommended. The merits are: savings in operation costs, prolonged life of fans and reduced negative effects (colder floors etc.). Operating periods of the fan should be adjusted according to continuous measurements of indoor radon concentration.

Numerical modelling is recommended for the optimisation of the design (fan power and location of points for suction of air from the gap). At this time one model is available - TLAK3D that solves pressure and air velocity fields in three dimensions.

Further Information

More detailed information can be found in the Czech Standard CSN 730601 “Protection of houses against radon from the soil”, in detailed guides published by State Office for Nuclear Safety and on website www.suro.cz. All these information are in Czech language.

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