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Rasmussen, Torben Valdbjørn

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Radon Sub-slab Suctioning System Integrated in Insulating Layer

T. Valdbjørn Rasmussen
Danish Building Research Institute, Aalborg University

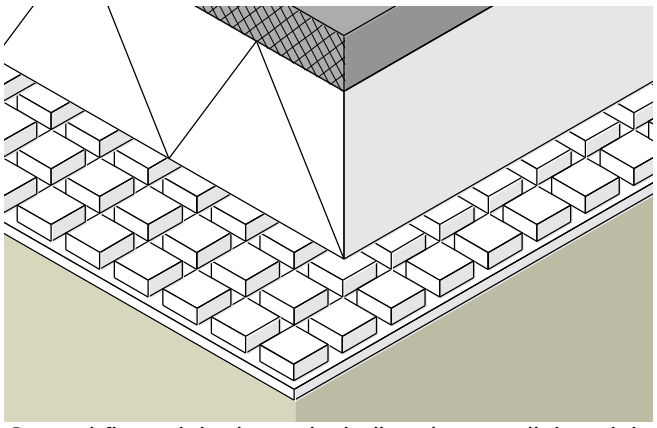
SUMMARY
This poster presents a new radon sub-slab suctioning system. This system makes use of a grid of horizontal pressurised air ducts located within the lower part of the rigid insulation layer of the ground floor slab. For this purpose a new system of prefabricated lightweight elements is introduced. The system is shown to be effective in preventing radon from polluting the indoor air by introducing low pressure in the horizontal grid of air ducts. How to implement and use the system in an effective way is described.

Introduction
Radon is a radioactive gas that develops as a result of the decay chains of uranium and thorium in the ground [1]. Radon mainly penetrates into a building by air infiltration through cracks or other unintended openings in the ground floor slab [2], ground materials and ground water. Radon is without colour, smell, taste or sound and can therefore only be detected through measuring [1].
Radon is responsible for 3-14% of lung cancer incidents, depending on the average radon exposure in various countries [3]. Results show radon to be the second-largest cause of lung cancer. Smoking is still the principal cause.
Radon exposure must be taken serious in the fight against radon-induced lung cancer due to the large number of people that are exposed daily in buildings and especially in residential buildings [3], as a large number of residential buildings are constructed with a floor slab on ground.

Sub-slab Suctioning
The most effective way of preventing air that may contain radon from infiltrating from the ground into a building is considered to be a radon-suctioning system [4]. The principle is to lower the pressure within the lower part of the ground floor slab of the building.

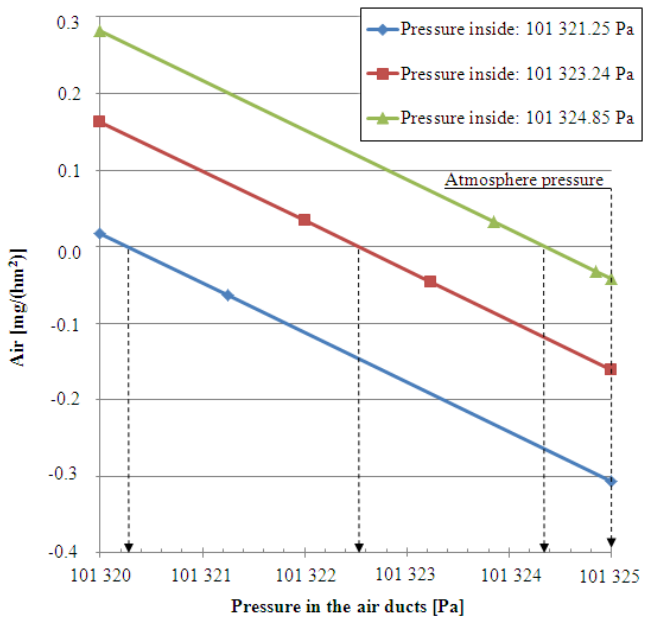
New system
The new principle for radon protection makes use of a system of horizontal pressurised air ducts located within the lower part of the rigid insulation layer of the ground floor slab. The function of this system is based on the principles of pressure reduction within the lower zone of the ground floor construction. The new system of prefabricated lightweight elements consists of the capillary-breaking layer and a pressure reduction zone which is working as the radon-suction layer. The radon-suctioning layer is formed from a grid of horizontal air ducts with low pressure which are able to remove air and radon from the layer.
The pressure reduction within the radon-suction layer can either be passive or active, i.e. creating suction through the stack effect only or creating suction by means of mechanical ventilator. A pipe can be led directly from the radon-suctioning layer and above the roof. Suction is introduced through the pipe to the radon-suctioning layer.

Prefabricated element
The effectiveness of the system is demonstrated for the case of a ground floor reinforced concrete slab situated on top of a rigid insulation layer (consisting of a thermal insulation layer located on top of a capillary-breaking layer) mounted in turn on stable ground.



Ground floor slab shown including the new lightweight sub-slab suctioning system.

Results
Air moving through the upper surface of the ground floor concrete slab was calculated using a finite difference program. Positive values represent air moving, through the upper surface of the concrete slab, towards the radon-suction layer, avoiding radon being accumulated inside the house.



Amount of air moving through the upper surface of the reinforced concrete slab.

Lack of radon protection
Radon accumulated inside new and old detached houses constructed without a sub-slab suctioning system has been measured.

New detached houses: *In 2007, measurements of radon concentration were made in new Danish detached residential buildings, constructed with a slab on ground with a high radon concentration. They showed that 1% of these dwellings had a radon concentration in the indoor air above 200 Bq/m^3, and 7% had a concentration above 100 Bq/m^3 [5]. Measurements were made in 200 detached residential buildings constructed between 2005 and 2007.*

Older detached houses: *In the winter 1994-95, measurements of the radon concentration was made in Danish detached residential buildings, built with a slab on ground with a high radon concentration. They showed that 7.7% of these dwellings had a radon concentration in the indoor air above 200 Bq/m^3, and 15.6% had a concentration above 100 Bq/m^3 [6]. Measurements were made in 270 detached residential buildings constructed before 1995.*

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