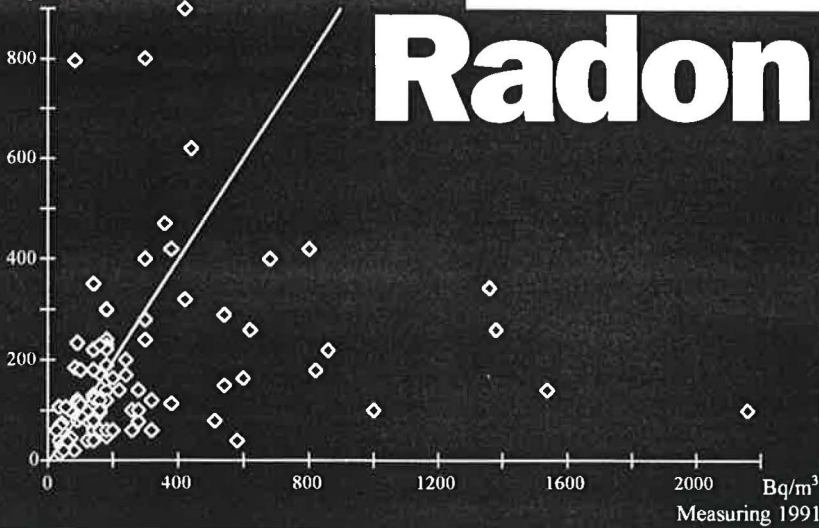


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Radon remedial do not

Measuring after mitigation

Bq/m³



The figure shows radon contents measured immediately after remedial measures and during check measurements in 1991. Points to the right of the diagonal indicate that the radon content in the building was higher in 1991 than previously.

Radon remedial measures do not last. After a few years the radon contents are again at a high level. This is shown by check measurements made in 110 dwellings in Sweden in which remedial measures against radon have been carried out.

It is now 16 years since the first limit values for radon in dwellings were laid down in Sweden. For sanitary inconvenience the value was put at 400 Bq/m³ in relation to the annual mean radon daughter content. Now the figure of 400 Bq/m³ is the limit value for radon gas content.

In 1993 radon surveys were made in about 230 000 dwellings. In 35 000 of these the radon content exceeded the limit value for sanitary inconvenience, but it was considered that there were almost 100 000 more to be located. Remedial measures in relation to the elevated radon contents were taken in 9 500 dwellings.

The results of remedial measures were however highly variable. In 41% of the dwellings the results were so satisfactory that the radon content was below the limit value for a new building (200 Bq/m³), but in 16% of the dwellings the radon content still constituted a sanitary inconvenience.

Checks on the lasting effects

It is very well to check the radon content after measures. But, even if the radon content has been successfully reduced to an acceptable level now, what will the results be in future?

In a research project financed by the Swedish Council for Building Research and the National Institute of Radiation Protection, this has been investigated. In 110 decontaminated dwellings, comprising 90 single-dwelling houses and 15 flats in

blocks of flats, radon contents are checked once every three years over a 10 year period. The air change rate is measured at the same time in those dwellings where it is of critical significance for radon content, e.g. where the existing natural ventilation was improved or some form of mechanical ventilation was installed. Measurements of air change rate are made with different tracer gases according to the AIM method. The first check measurements within the framework of the project were made in 1991.

Have again increased

The results of measurements in 1991 showed that the radon content had markedly increased in about 40 % of the single dwelling houses in relation to the content measured after the sanitary measures. In 18 of these the content was so high that it constituted a sanitary inconvenience.

Measurements in 1994 showed about the same results. The radon content was still above the limit value for sanitary inconvenience in 12 single dwelling houses and in a further 4 which had appeared since 1991.

The causes of the elevated radon contents were studied in a recently concluded project which is reported in "Why radon contents increase in buildings where radon remedial measures have been taken" (in Swedish), (A1:1997). The project comprises the 31 buildings in which the greatest increases in radon content had occurred.

The following remedial measures had been taken:

- The existing natural ventilation system was converted to a mechanical exhaust air system in 5 buildings,
- The existing natural ventilation system was converted to mechanical supply and exhaust air ventilation system in 7 buildings,
- A radon subslab suction was installed and the existing natural ventilation system was converted to mechanical supply and exhaust air in 3 buildings,
- A radon subslab suction was installed in 4 buildings,
- A radon well were installed in 5 buildings,
- The existing natural ventilation system was adjusted and improved in 4 buildings,
- The foundation slab was insulated against soil radon in 1 building,
- In 1 building the raised floor construction in two rooms on the basement storey was complemented with ventilation,
- In 1 building, the ground below the building was provided with overpressure ventilation according to the air cushion principle.

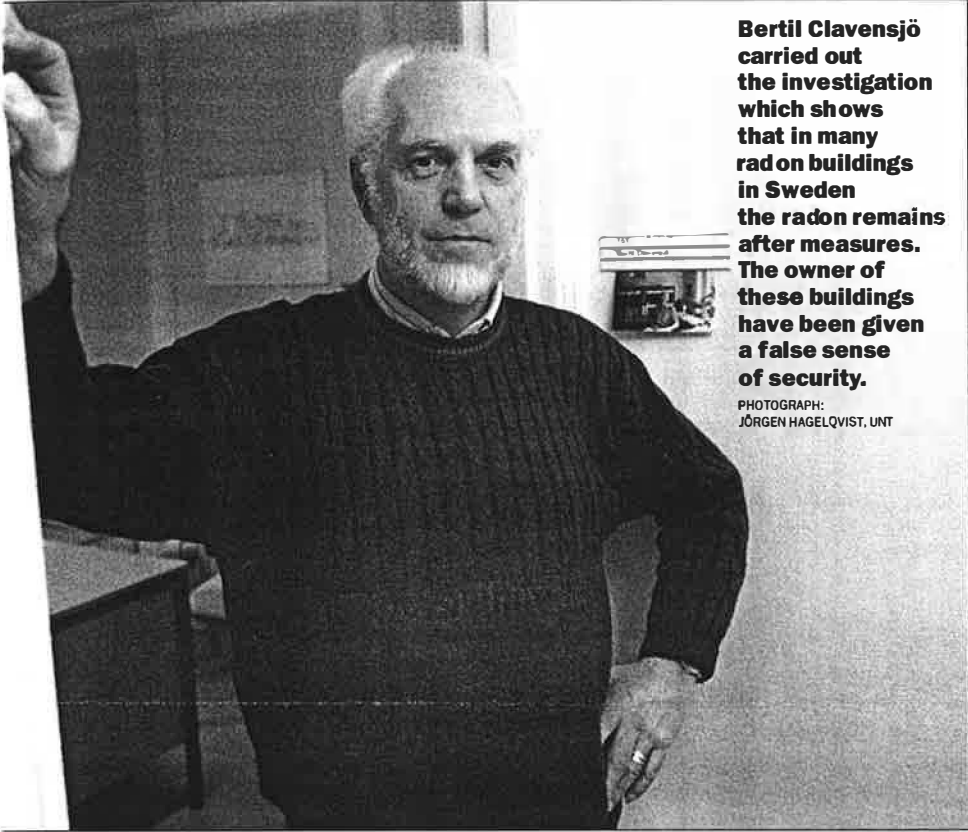
Choice of the wrong method

We found a lot of reasons why radon contents during check measurements were higher than immediately after remedial measures. In most buildings there is no single cause, but a combination of several causes.

The reason may for instance be that measurement immediately after the remedial measures was made

measures last

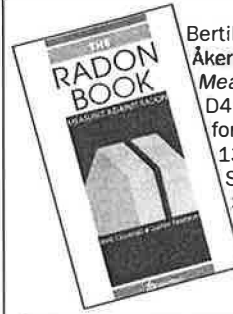
By Bertil Clavensjö



Bertil Clavensjö carried out the investigation which shows that in many radon buildings in Sweden the radon remains after measures. The owner of these buildings have been given a false sense of security.

PHOTOGRAPH: JÖRGEN HAGELQVIST, UNT

Bertil Clavensjö, the author of this article, is also one of the authors of THE RADON BOOK.



Bertil Clavensjö & Gustav Åkerblom, *THE RADON BOOK. Measures against radon*, D4:1994, Swedish Council for Building Research, 130 pp, SEK 370. Order: Sv Byggtjänst, S-113 87 Stockholm, Sweden, fax +46 8 457 11 00.

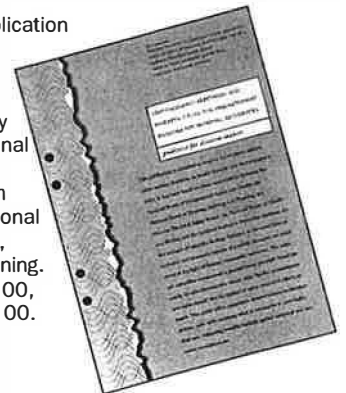
Low-frequency electrical and magnetic fields: Caution is recommended!

Five national authorities in Sweden have jointly published a guide (in Swedish, but also in English) for decision makers named "Low-frequency electrical and magnetic fields: The precautionary principle for national authorities".

The publication, it is said, is based on the strength of scientific findings hitherto, at the same time as technical and economic aspects of possible measures are considered in the light of limited community resources. It is intended as support for decision makers, when making decisions on health hazards and electromagnetic fields.

The five authorities recommend a precautionary principle based primarily on non-discountable cancer risks. According to the precautionary principle, the endeavour should be to reduce fields which are very different from what can be considered normal in the environment concerned – provided that action can be taken at moderate cost and that other consequences also are reasonable. In the case of new electrical installations, appliances and buildings, the aim already at the planning stage should be to design and site these so that exposure is limited.

Copies of the publication "Low-frequency electrical and magnetic fields: The precautionary principle for national authorities" are available from The Swedish National Board of Housing, Building and Planning. Tel +46 455-530 00, fax +46 455-531 00.



over far too short a period. During this time the radon daughter content was low, but was not representative for the building over an extended period.

Conversion from radon daughters to radon gas for comparison with the results of check measurements may also be a source of error. This does not mean that the radon content had increased, only that the content was evaluated on the basis of measurements immediately after the remedial measures. The property owner had therefore thought that the measures were considerably more effective than in actual fact, which is serious enough.

Another reason for the elevated contents was that the best remedial method had not been chosen in several buildings.

Fan speed was reduced

Reduction of the speed of the fan or fans forming part of the remedial measures is also a common cause of

increased radon contents. Measurements after the remedial measures had given such good results that it was thought the speed could be reduced to save energy or reduce the noise level.

There were also occupant related causes for the increase, for instance windows were opened to different extents during different periods, the composition of the family changed, or the building had a new owner. ■

Bertil Clavensjö works at Bjerking's Ingenjörbyrå AB, Box 2006, S-750 02 Uppsala, tel. +46 18-65 11 00, fax +46 18-71 04 85.

Literature

Bertil Clavensjö, "Why radon contents increase in buildings where radon remedial measures have been taken" (in Swedish), A1:1997, Swedish Council for Building Research, SEK 150. Available from Byggdok, tel. +46 8-617 74 50, fax +46 8-617 74 60.

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