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Fixing Houses with High Radon—A Canadian Demonstration

INTRODUCTION

Radon is a radioactive gas. It has the potential to cause lung cancer amongst those people exposed to it.

In 2007, as a result of new scientific findings, Health Canada (HC) lowered the federal indoor radon guideline for dwellings to 200 Bq/m^3 after consultation with provincial and territorial officials. See http://hc-sc.gc.ca/ewh-semt/radiation/radon/guidelines_lignes_directric e_e.html.[1]

More Canadian houses will now be above the federal guideline and awareness of radon is likely to increase among Canadians over the next several years. Health Canada, Canada Mortgage and Housing Corporation (CMHC) and other agencies are starting to provide more information on how to test for radon, how to remediate houses that have high radon levels and what areas of the country are most at risk. For more information, see the joint CMHC/HC publication *Radon: A Guide for Canadian Homeowners* at http://www.cmhc-schl.gc.ca/odpub/pdf/61945.pdf.

The small research project, funded by Health Canada and managed by CMHC, described in this highlight demonstrates that the techniques described in *Radon: A Guide for Canadian Homeowners* can be applied to Canadian houses and that the remediation technique involved, active sub-slab depressurization, can effectively lower radon to concentrations below the guideline.

A homeowner in the community of Kanata in western Ottawa contacted CMHC and Health Canada for advice on high radon concentrations he had measured in his new house. Figure 1 shows almost a month of radon readings from his basement. Note that the concentration fluctuates due to house operation, climate factors, and so on. A short reading of two days duration could give a reading as low as 150 Bq/m^3 (for example, Oct. 28) or as high as 2,700 Bq/m^3 (Oct. 19). For that reason, *Radon: A Guide for Canadian Homeowners* recommends that houses be tested for at least one month.

Averaged over the test period, the homeowner's results were in the order of 1,400 Bq/m^3, considerably in excess of either the new or old guideline. The basement had a poured concrete floor and walls, and was not remarkably different from neighbouring houses. It had a slab poured on polyethylene sheeting, which should reduce the radon entry rate.

[1] English and French. Retrieved March, 2008.

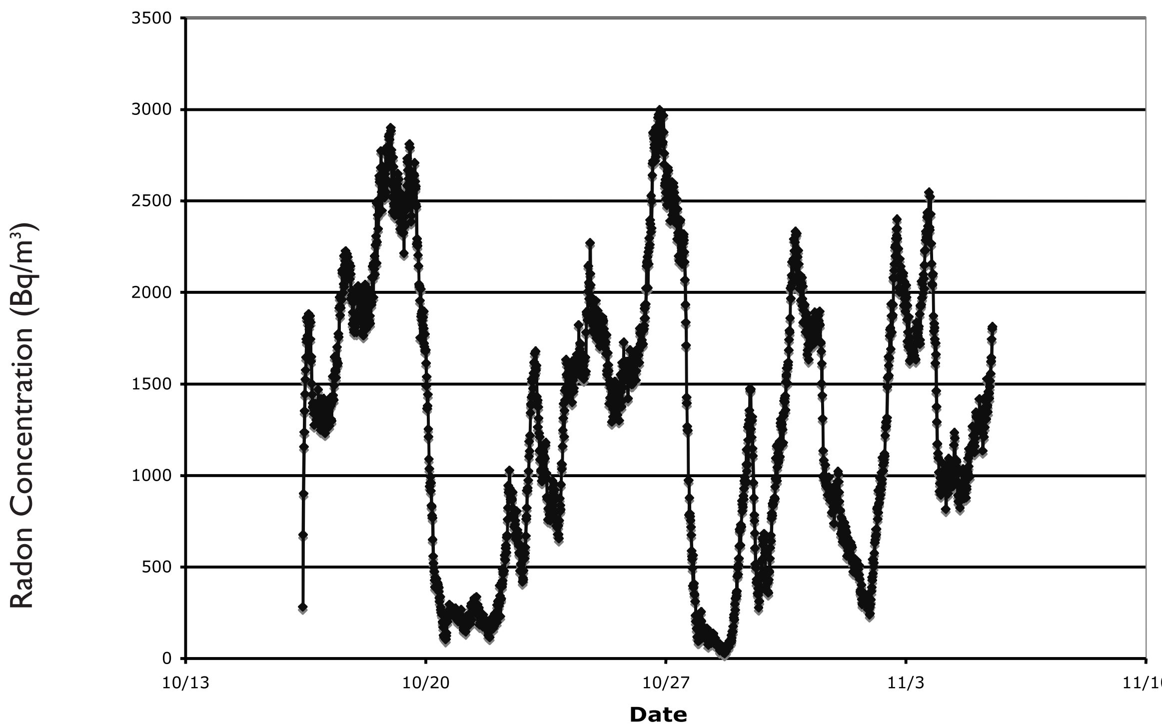

Figure 1 Continuous radon monitor trace, October–November, 2007

RESEARCH PROGRAM

The research program was quite simple: an experienced radon consultant visited the house with CMHC and HC scientists. The group reviewed the potential radon entry points and decided on a remediation strategy.

The recommended remediation, active soil depressurization (or sub-slab depressurization), involves having a fan draw air from underneath the concrete slab and exhaust it outside. This causes a pressure change. Air beneath the slab usually has a positive pressure during the heating season, so the radon moves from the soil, through cracks and holes in the slab, and into the house. A sub-slab depressurization system withdraws air from this space, making its pressure less than in the house above. Any air movement now is from the house, through the cracks, to the soil. This pressure change keeps radon out of the house air.

The consultant drilled several small holes in the floor to measure whether all the air contained in the gravel layer under the slab could be depressurized by an exhaust fan connected through the slab at a single entry point. A ventilation contractor installed the fan and ducting to the consultant's recommendations, and the system was activated.

The exhaust fan discharged the sub-slab air at grade and not at roof level, as recommended by the United States Environmental Protection Agency (EPA). This was due to concerns regarding the possible condensation and ice build-up problems within vertical vents on the outside of houses in cold Canadian climates. The project team felt that, if re-ingestion of the exhausted radon through windows, doors or other envelop leakage points in the vicinity of the exhaust fan discharge point was a large factor, the post-mitigation test would show high levels of radon inside the house. The radon concentrations were measured for a month in the winter following installation of the system. Figure 2 shows the basement, the location of the measurement holes (B, C), and the fan and ducting system.

RESULTS

The system was remarkably effective (see Figure 3). Radon concentrations dropped from an average of 1,400 Bq/m³ to about 40 Bq/m³ for the month following, significantly below the HC 200 Bq/m³ guideline. The homeowner was happy with the installation of the system and with the results. Re-ingestion of the exhausted radon was not a significant factor in this location during this period.

During the commissioning of the system, the fan flow was not quite high enough to make a consistent depressurization at the test holes B and C shown in Figure 2. This was cause for some concern, but it was decided to run the fan for a month and monitor its effectiveness before looking for a way to increase fan flow.

As the mitigation system proved effective, even in mid-winter with the highest competing pressures, there has been no adjustment to the fan flow. The homeowner has some flexibility in the future to do such modifications, as the fan speed can be modulated, and he is able to monitor the results of impact on radon concentrations with a continuous radon monitor. He could reduce the fan flow rates to save electricity (associated with fan motor operation) if he ascertained that the radon concentrations still remained low in the house. For homeowners who have not purchased their own radon monitors, this fan optimization would not be available to them.

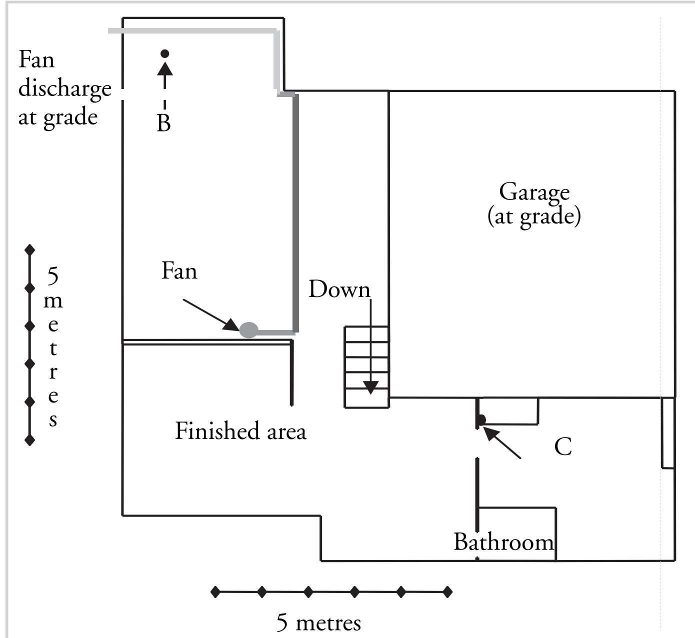

Figure 2 Installed fan and piping layout

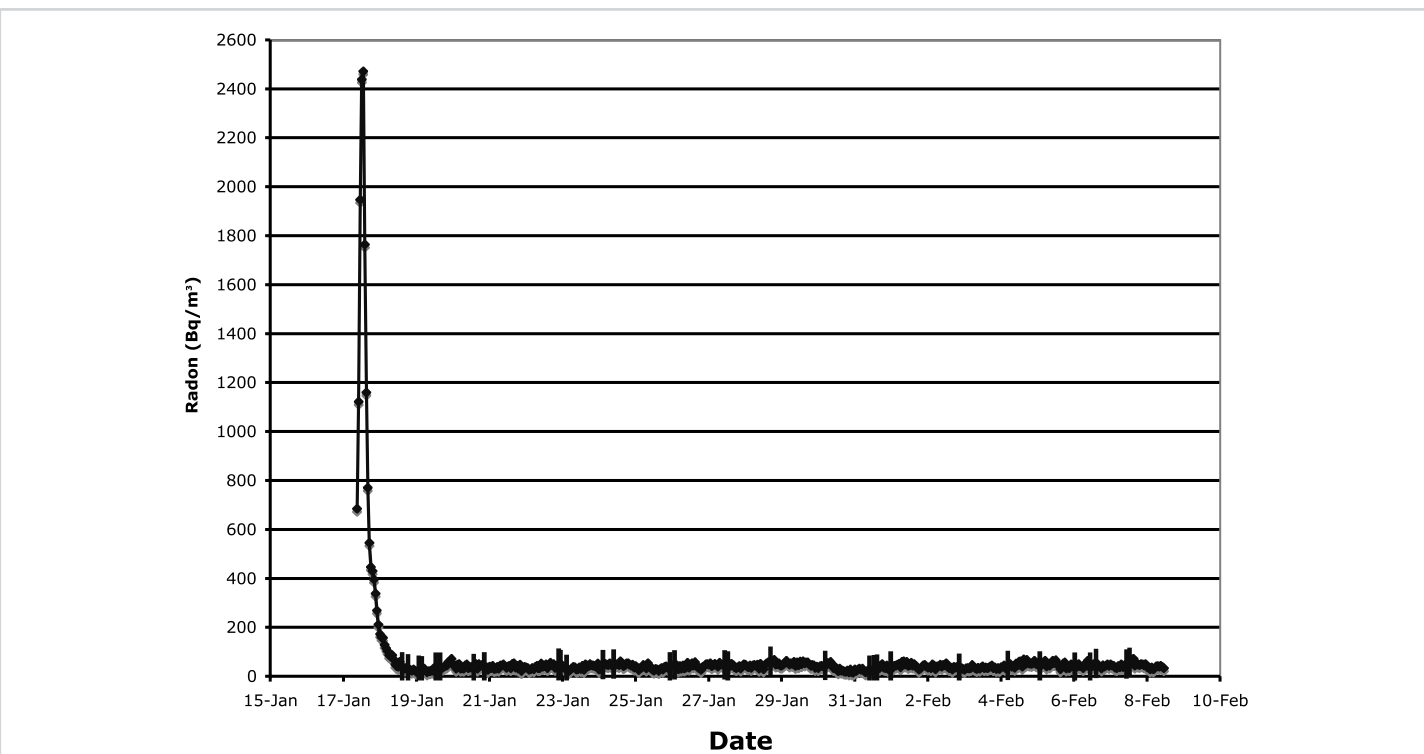

Figure 3 Continuous monitor trace during and after mitigation

CONCLUSIONS:

This small project showed that active soil depressurization, or sub-slab depressurization, as described in HC/CMHC publications, worked effectively at reducing radon concentrations in the indoor air of a house troubled by excessive radon levels.

A ventilation contractor, with no radon experience, installed an effective mitigation system following this advice. The results also illustrate the need for a month-long test (or longer) both before the work, for diagnosis, and following installation of the system, to measure the success.

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Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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