DOE Program
Reports on the DOE OHER Radon Research Program

CSU Underground Laboratory

Concentration and Entry Don't Always Coincide

During the past few years, much information has been presented on indoor radon concentrations. This has included short-term screening surveys in basements, determination of long-term average concentrations in houses, and experiments that show the time variations in individual homes. Only a few studies, however, have reported the rate at which radon enters a structure and the factors that control the rate. It has often been assumed that high entry rates will usually cause high indoor concentrations.

Thomas Borak of Colorado State University (CSU) is measuring the entry rate and the factors that control entry in underground structures that he and his students designed to simulate typical basements in the western United States.

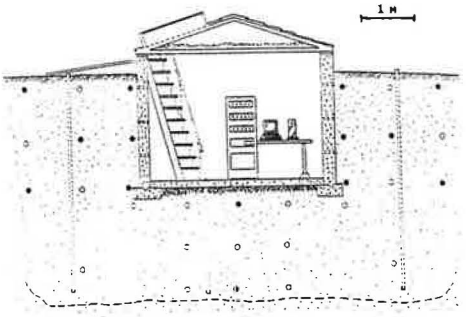

Fig. 1. Two identical underground structures similar to this one were constructed on the CSU campus.

His study is designed to determine factors that control entry and accumulation of radon into underground structures. His experimental data can also be used to test and validate radon transport models that might eventually be used to predict entry and concentration for other types of soil in different parts of the United States and for different types of basements.

The facility will also be used to test the hypothesis that deep-rooted plants can alter the characteristics of the soil surrounding a structure and influence the transport and entry of radon.

The experimental design is based on construction of two identical underground structures so that one can serve as a control while experiments are performed in the other. (A report in *Radon Research Notes*, February 1991, No. 3, described the structures and discussed Borak's research goals.)

The miniature basements are fabricated using conventional construction techniques. They are a compromise between a simple hole in the ground and a fully occupied house. A schematic is shown in Fig. 1.

Each structure is equipped with sensors that monitor soil properties (temperature, moisture, and pressure differentials) and indoor atmospheres (temperature, ventilation, and radon concentration). A meteorological station at the site monitors barometric pressure, temperature, wind speed, and wind direction. A computer-controlled data acquisition system accumulates, sorts, and stores over 6000 measurement points per day.

Radon entry rates can be divided into a constant term that is independent of the pressure differentials between the soil and interior of the structure and a time-varying component that depends on pressure differences.

The results, using a continuous determination of natural ventilation, show that the indoor concentration is not always correlated with radon entry. Frequently, the indoor concentration actually decreases when the radon entry increases. This is illustrated in Fig. 2, which shows daily averaged measurements during the winter of 1990. Ventilation rate (A) and radon entry rate (B) are strongly associated with wind speeds (C). However, the radon concentration (D) actually drops because the winds that increase pressure-driven flow of radon into the structure are also responsible for increased ventilation. The highest radon concentrations occur during calm conditions when the entry rate is slow (i.e., dominated by diffusion) and independent of pressure differentials.

The considerable variation noted in ventilation rates in the structures probably also occurs in most houses, Borak said. Other experiments that did not find this variation may have relied primarily on spot measurements. Because instruments in the test structures take readings every 15 min, the variations were observed.

Experiments are now being performed to separate the components of radon entry into the part that passes through the concrete and the part that enters through floor-wall interfaces. Sealing the floor-wall joints in one structure has reduced the average radon entry rate by about 25%. However, most of this reduction occurs for very high radon entry rates that were previously associated with pressure differences.

Data are also being analyzed to characterize the contribution of radon entry from and through the concrete floor and walls.

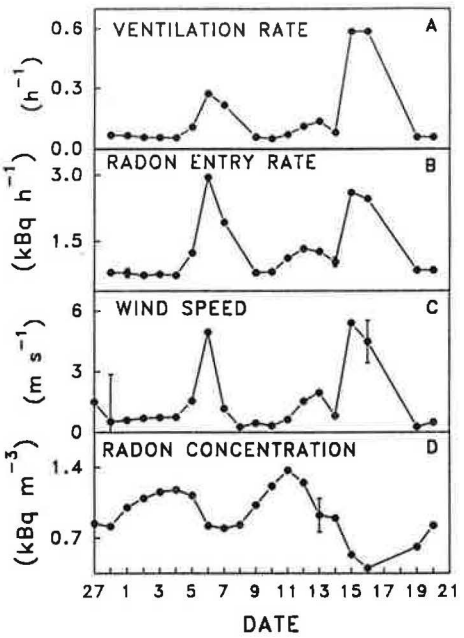

Fig. 2. Daily average measurements during winter of 1990.

Soil permeabilities at the site are representative of the front range region of Colorado and of similar geological areas. Borak and his students are using computer models in an effort to learn whether the data can be extended to other soil types.

Researchers at Lawrence Berkeley Laboratory in California have instrumented two small basement structures. These are located in more permeable soils, where the dominant source of radon is pressure-driven flow from the soil into the basement. Comparative information from the sites in Colorado and California might be useful.

In summary, the purpose of the experiments conducted by Borak and his students is to understand the fundamental mechanics that influence the transport and entry of radon into structures. These experiments can identify those conditions that either enhance or reduce indoor radon concentrations. The information is important in developing cost-effective methods to control radon and reduce exposure to occupants. ▲

Reported by Naomi Harley, NYU

DOE/CEC Program Managers Meet

The 5th U.S. DOE/Commission of European Communities (CEC) Program Managers meeting was held July 14–17 at Niagara Falls, Canada.

Participants at the meeting, held under terms of a bilateral memorandum of understanding, discussed activities of common interest in the area of radiation protection research. Plans for a collaborative radon project that is expected to include research on sources, pathways, and modelling were discussed.

In addition to radon, agenda topics included Chernobyl, microdosimetry, global change, radiation health effects, nuclear medicine, and radioecology.

Attending from DOE were David Galas, Robert Wood, Susan Rose, David Smith, Matt Varma, John Peeters, Michael Ginevan, Murray Schulman, and Marvin Frazier.

Attending from the CEC in Brussels were Jaak Sinnaeve, Hans Menzel, Gilbert Desmet, Ken Chadwick, Hannelore Schibilla, Neil Kelly, and Felix Luykx.

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