



Project Summary

New House Evaluation of Potential Building Design and Construction for the Control of Radon in Marion and Alachua Counties, Florida

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The report describes the approach, methods, and detailed data used to evaluate the effectiveness of different radon entry controls into new houses. The main objective focused on finding engineering solutions to controlling radon entry into houses. The overall resistance of the building to radon soil gas entry and the dynamic forces that influence building performance were examined.

The New House Evaluation Project is directed toward developing standards for radon-resistant new home construction. Once adopted, these standards will become part of the building construction codes of Florida counties and municipalities.

The analysis was based on 14 new houses built in accordance with the Draft Florida Standard for Radon-Resistant Building Construction. There are three approaches to reducing radon levels in the construction of new houses:

- 1) preventing radon entry by using barrier methods;
- 2) reducing the radon entry driving forces; and
- 3) diverting the radon from entering the houses by sub-slab depressurization.

Approaches 1 and 2 are passive. The passive approaches used in construction include placement of a vapor barrier, sealing of plumbing penetrations, mixing of floor slab concrete with superplasticizers, reinforcing of slab at reentrant corners, and proper slab curing and loading.

Approach 3 is active. A fan was used to depressurize the sub-slab, making sub-slab pressure lower than the indoor pressure.

Research measurements focused on soil conditions at each building site, as well as the physical conditions of the building and dynamic forces after construction completion. Soil measurements included radium content, soil permeability, moisture content, and physical characteristics. Building measurements included air leakage rate, soil gas entry rate, radon concentrations, and floor slab crack dimensions. The building dynamics tests included pressure effects of the heating and air-conditioning systems and the active sub-slab depressurization fan on the indoor and sub-slab environment. After construction completion, houses were evaluated using short-term indoor radon tests. All houses were tested; the indoor radon levels in all houses were found to be under the limit of 4 pCi/L prescribed by the Florida Department of Community Affairs.

This project summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The New House Evaluation Project of the Florida Radon Research Program is a continuation of major studies directed to-

ward developing standards for radon-resistant new home construction. Once adopted, these standards will become part of the building construction codes of Florida counties and municipalities.

The project objectives are accomplished at several stages: 1) preconstruction; 2) during construction, and 3) postconstruction.

At the preconstruction stage, selections were based on soil with high radon levels. When the potential sites were identified, a contract was drawn between the University of Florida (UF) and the home builders.

During the house construction process, the UF researchers conducted various activities including the placement of a vapor barrier, sub-slab depressurization (SSD) system, concrete slab crack measurements and radon tests through cracks, etc.

House dynamic tests were performed during post construction.

In general, UF researchers found that use of ventilation matting and proper sealing of radon entry points will maintain the indoor radon level below the EPA level.

1. At the preconstruction stage the following tasks were performed:

- a) selection of potential residential sites with native soil gas radon level equal to or greater than 1,000 pCi/L;
- b) site characterization consisting of a series of insitu measurements and collection of soil and fill samples for laboratory analysis of moisture content, soil permeability profile, soil gas radon, radon emanation coefficient, etc.

2. During construction, UF research involved the following activities:

- a) design and installation of sub-slab depressurization system composed

of ventilation matting and radon gas suction points with a piece of 3-in (7.6-cm) polyvinyl chloride (PVC) inserted into a toilet flange by attaching it to the mat. Testing points were selected and small Enkavent pads were placed and connected to 3/16-in (0.48-cm) plastic radon gas testing tubes beneath each pad that were run under the slab to the outside construction foundation walls for taking radon gas measurements.

- b) pressure field mapping produced by measuring radon gas from the 3/16-in plastic testing tubes.

3. During postconstruction, the following tasks were performed:

- a) house dynamics tests using the blower door test to assess the tightness of the house envelope, and locate and quantify leaks in the air distribution system. The houses were pressurized to about 15 Pa by the blower door, with the air handler turned off, and smoke (titanium tetrachloride) from a smoke stick was placed in front of each supply and return register to observe the speed with which it entered each register. If the smoke entered slowly or not at all, then little or no duct lead existed nearby in the ducts. If, on the other hand, smoke entered the register rapidly, then a large duct leak was nearby.
- b) sub-slab radon sampling at each site under a number of different house conditions (e.g., vent capped, vent uncapped, and active fan). These tests were performed at various stages of construction (e.g., after slab was poured and framing of the house had begun).

- c) indoor radon sampling tests under different conditions: vent capped, vent uncapped, and with active fan. In addition, a number of different methods were used for the indoor testing.

The data collected under these sampling methods were used in the analysis of indoor radon levels. Each technique provided discussion on the evaluation and effectiveness of various construction measures. The data were used in various models which provided details that allow applications ranging from statistical treatment of house parameters to detailed house-specific models that require a large amount of input data.

Conclusions

This research resulted in several conclusions.

- 1) A screening technique consisting of "sniff" sampling of radon soil gas measurements with a selection criterion of 1,000 pCi/L was effective in finding sites with an elevated radon source potential.
- 2) The correlation between preconstruction site characterization soil gas radon measurements and postconstruction sub-slab radon measurements was weak.
- 3) The indoor radon concentration ratio between an uncapped ventilation system and a capped ventilation system can be examined as possible evidence of a passive ventilation effect.
- 4) The passive barrier was sufficient to maintain indoor concentrations below the 4 pCi/L action level when sub-slab concentration was less than 3,000 pCi/L.
- 5) The very limited data from this study support the role of active SSD as an effective radon control technique.

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The complete report, entitled "New House Evaluation of Potential Building Design and Construction for the Control of Radon in Marion and Alachua Counties, Florida," (Order No. PB96-168299; Cost: \$47.00, subject to change) will be available only from:

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