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Project Summary

Evaluation of Building Design, Construction, and Performance for the Control of Radon in Florida Houses: Evaluation of Radon Resistant Construction Techniques in Eight New Houses

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Eight houses were studied throughout their construction in North Central Florida. Each house was built in compliance with the proposed radon resistant construction standard being developed by the Florida Department of Community Affairs. Post-construction monitoring was performed over a minimum 6-day period for each structure during which each house was operated in three different heating, ventilation, and air-conditioning (HVAC) system configurations. Continuous measurements of indoor radon concentrations, house ventilation rates, across-slab differential pressures, and interzone differential pressures provided time resolved radon entry rates and a performance index for passive radon barriers. Radon entry rates were found to be relatively constant throughout the measurement periods and for different house operating conditions, implying that the passive radon barrier eliminates the majority of convective entry. The passive barriers maintained radon entry fluxes at less than 1.2 pCi m^{-2} s^{-1} for sub-slab radon concentrations as high as 9,500 pCi1^{-1}.

The study results also demonstrate that the operation of well designed and constructed HVAC systems do not significantly affect indoor radon concentrations, regardless of the pressures that may be induced between interior air zones. House ventilation rates should, however, be equal to or greater than 0.25 air change per hour in order to prevent the accumulation of elevated radon concentrations since passive barriers do not block 100% of the radon from entering.

This Project Summary was developed by EPA's National Risk Management Research Laboratory, 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).

The State of Florida has undertaken the development of radon resistant construction standards for newly constructed buildings in the state. This is a premier effort to develop a technically based building code for both residential and large/commercial buildings and focuses on the specific construction practices and environmental conditions found in this region of the country.

The work presented here consists of an evaluation of the effectiveness of the radon resistant construction standards for residential construction which will enter the rule-making process later this year

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Radon entry rates were calculated from the measured parameters. The resulting radon entry rates were relatively constant throughout the measurement periods and for different house operating conditions, with variations of indoor radon concentrations being driven predominantly by the house ventilation rate. Normal cycling in the barometric pressure produced a semidiurnal cycle in the across-slab differential pressures in all of the houses studied. These differential pressures did not, however, correlate with observed changes of the radon entry rate, indicating that pressure driven flow is not providing a major contribution to the radon entry. These results imply that the passive radon barrier effectively reduces a large fraction of the convective driven entry. Similarly, averaged radon entry rates and entry fluxes were not correlated to the foundation slab cracking present in these structures. Although measures were taken to reduce the amount of slab cracking, half of the slabs studied exhibited some unplanned slab cracks.

A general figure of merit, the entry rate per unit slab area, or radon entry flux is useful and suggests that residences built using the radon resistant construction standard should be able to have entry fluxes less than about 1.2 pCi m^{-2} s^{-1}. It does not appear that sub-slab radon concentrations were high enough to overcome the effectiveness of passive barriers reached in this study. The passive barriers have demonstrated their effectiveness at maintaining radon entry fluxes at less than approximately 1.2 pCi m^{-2} s^{-1} for sub-slab radon concentrations as high as 9,500 pCi l^{-1}. If passive barrier techniques become ineffective at some concentration of sub-slab soil gas radon, it is probably greater than 10,000 pCi l^{-1}. In fact, we observed excellent performance for House #11 at 9,500 pCi l^{-1}, which had quite a low radon entry flux. This research provides support for and suggests some changes to the current version of the radon resistant construction standards in several areas. Overall the study demonstrates that the implementation of passive barriers can be practically incorporated in foundations during new house construction and that, when implemented as prescribed by the standards, can successfully prevent indoor radon concentrations from exceeding the 148 Bq m^{-3} guidelines in most houses.

The study results also demonstrate that the operation of well designed and constructed HVAC systems (i.e., those built to current building code standards) does not significantly affect indoor radon concentrations, regardless of the pressures that may be induced between interior air zones. Therefore, there should be no requirement for the radon resistant construction standards to include provisions to transfer air between different air zones within a structure such as transfer grills, and door undercuts. A more important subject with which HVAC systems do interact is the overall house ventilation rate. It appears to be prudent to ensure an average house ventilation rate equal to, or greater than, 0.25 air change per hour in order to prevent the accumulation of elevated radon concentrations, since passive barriers do not block 100% of the radon from entering.

The radon resistant construction standards developed for residential construction by the Florida Department of Community Affairs have been demonstrated to be technically feasible and can be implemented on a practical basis. Passive barrier techniques can provide houses constructed over sandy fills and high soil gas radon concentrations with acceptable indoor radon concentrations as long as house ventilation rates are not permitted to be too low, and active soil depressurization continues to be an inexpensive and very effective backup to passive barriers.

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The complete report, entitled "Evaluation of Building Design, Construction, and Performance for the Control of Radon in Florida Houses: Evaluation of Radon Resistant Construction Techniques in Eight New Houses," (Order No. PB95-253910; Cost: $27.00, subject to change) will be available only from
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