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Project Summary

Standard Measurement Protocols, Florida Radon Research Program

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In support of the Florida Radon Research Program (FRRP), a manual was compiled containing standard protocols for key measurements where data quality is vital to the program. This manual is divided into two sections. The first section, soil measurements, contains field sampling protocols for soil gas permeability and radon concentration, in-situ soil density, soil classification, and penetrometer analysis. Laboratory procedures include soil moisture, radium and radon emanation, particle-size analysis, specific gravity, the proctor method for moisture/density relationships, a laboratory gas permeability test, a radon diffusion coefficient measurement, and two radon flux measurements. The second section, building measurements, includes diagnostic procedures for sub-slab radon, sub-slab communications, and differential pressure measurements followed by building leakage measurements.

This Project Summary was developed by EPA's Air and Energy Engineering 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).

Introduction

As mandated by the 1988 Florida Legislature, the Florida Department of Community Affairs (DCA) is required to develop construction standards for radon resistant buildings and for mitigation of radon in existing buildings. In order to lay technical groundwork for these standards, the DCA has established the Florida Radon Research Program (FRRP), an extensive program of research and development ranging from fundamental studies to demonstrations and field validations.

To ensure the quality of data generated by multiple research groups in the FRRP, key measurements have been identified and standardized. The standard measurement protocols for these key measurements were compiled into a manual that is intended to be distributed to all research groups participating in the FRRP. Every attempt was made to use validated and generally accepted methods for each measurement with a minimum of modification. Thus, methods that have been documented by the American Society for Testing and Materials (ASTM) were used whenever applicable. Likewise, several radon-related protocols developed or standardized by the U.S. Environmental Protection Agency (EPA) have been incorporated into this manual.

Standard Measurement Protocols Included in the Manual

1.0 Soil Measurement

1.1 Permeability/Soil Radon/Soil/ Fill Sample Collection

Field Procedures for Soil Gas Permeability and Radon Measurement, and Corresponding In-Situ Soil Density Sampling: A protocol for field measurement of soil gas permeabilities and collection of soil gas radon samples, corresponding field-density soil samples, and additional soil grab samples for particle size, soil moisture, and radiological analyses.

1.2 In-Situ Soil Density

In-Situ Soil Density Sampling Procedure (Rogers & Associates): Instructions for collecting samples for in-situ soil density measurements at locations which correspond to in-situ gas permeability measurements using the RP-2 permeometer.

ASTM D 2937-83 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method: A method for the determination of in-place density of soil by the drive-cylinder method.

1.3 Soil Classification

Soil Texture, Coarse Fragments, Stoniness and Rockiness, Appendix I: Terms Used to Describe Soils, In: Soil Taxonomy, U.S. Department of Agriculture, Washington, D.C. December 1975: Guidance material for definitions of soil textural classes on the basis of size distributions and for field classification in terms of visual-manual procedures.

ASTM D 2487-85 Standard Test Method for Classification of Soils for Engineering Purposes: A method for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle-size characteristics, liquid limit, and plasticity index.

ASTM D 2488-84 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure): A method for describing soil for engineering purposes and for identifying soils based on the classification system described in ASTM D 2487.

1.4 Penetrometer Analysis

Protocol for Soil Density Profiling Using a Barkley & Dexter Model HP-102 Penetrometer: A protocol for the use of a hand cone penetrometer to profile soil density gradients of undisturbed native soils, prepared soil fills (pre-slab), and post-construction sub-slab soils (both fill and native). Specifically, operating and maintenance instructions for the Barkley & Dexter Model HP-102 Soil Penetrometer are given.

ASTM D 1586-84 Standard Method for Penetration Test and Split-Barrel Sampling of Soils: A method for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.5 Soil Moisture

ASTM D 2216-80 Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures: A method for the laboratory determination of moisture content of soil, rock, and soil-aggregate mixtures by weight.

1.6 Soil Radium Content/Radon Emanation

Measurement of Radium-226, Radon Emanation Coefficient, and Moisture Content on Large (≈Quart) Core and Surface Samples: A combined protocol for the measurement and calculation of radium content, emanation coefficient, and moisture content of soil samples. Counting is done with a high resolution gamma spectroscopy system.

1.7 Soil Particle-Size Analysis

ASTM D 422-63 (Reapproved 1972) Standard Method for Particle-Size Analysis of Soils: A method for the quantitative determination of the distribution of particle sizes in soils.

1.8 Specific Gravity of Soils

ASTM D 854-83 Standard Test Method for Specific Gravity of Soils: A method for the determination of the specific gravity of soils by means of a pycnometer.

1.9 Standard Proctor

ASTM D 698-78 Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop: A method for the determination of the relationship between the moisture content and density of soils and soil-aggregate mixtures when compacted in a mold of a given size with a 5.5-lb rammer dropped from a height of 12 in.

1.10 Laboratory Permeability

Procedure for Laboratory Measurements of Air Permeability of Sub-Slab Land Fill (University of Florida): A procedure to measure air permeability of a soil sample by applying a known vacuum to the sample and measuring air flow.

1.11 Radon Diffusion Coefficient

Comparison of Radon Diffusion Coefficients Measured by Transient-Diffusion and Steady-State Laboratory Methods (Rogers & Associates): A method for determining radon gas diffusion coefficients based on measurement of the non-equilibrium or transient movement of radon through a sample material, rather than on the more traditional steady-state transport of radon through the sample.

1.12 Radon Flux

Radon Flux Measurement by Charcoal Cartridge (University of Florida): A method for radon flux measurements made by a charcoal absorber technique. The collected radon is measured by gamma counting of the cartridge, and the radon flux is calculated from the measured radon.

Radon Flux Measurements (Florida State University): This method is similar in principle to the University of Florida version, except that 25-g diffusion barrier canisters of the University of Pittsburgh design are deployed.

2.0 Building Measurement

2.1 Sub-Slab Radon

Alpha Scintillation Cell Sub-Slab Grab Samples (EPA/AEERL): A method for obtaining sub-slab grab samples and measuring counting data from scintillation cell samples with a portable photomultiplier tube scintillation counter.

2.2 Sub-Slab Communication Test

Sub-Slab Communication Test: A method for the quantitative characterization of the potential for air flow and pressure field extensions along all house shell surfaces in contact with soil by inducing sub-slab depressurization using a vacuum cleaner.

2.3 Differential Pressure Measurements

Differential Pressure Measurement Protocol: A method for measuring pressure differences which occur within a house and across the house envelope, including the floor/slab, as a result of ambient effects and the effects of mechanical equipment.

2.4 Building Leakage

2.4.1 Blower Door

This section contains the primary ASTM reference for fan pressurization, followed by a one page suggested addendum.

ASTM E 779-87 Standard Test Method for Determining Air-Leakage Rate by Fan Pressurization: A method for measuring air-leakage rates through a building envelope under controlled pressurization and depressurization.

Test Method for Determining HAC Duct System Leakage: A method for measuring the air-leakage rates through a heating and air-conditioning (HAC) duct system under controlled depressurization. The method consists of mechanical depressurization of a building and its HAC duct system and measurements of the resulting air flow rates at five indoor-outdoor static pressure differences.

2.4.2 Tracer Dilution

This section contains the primary ASTM reference for tracer dilution, followed by a modified procedure to measure changes in infiltration rate induced by mechanical air handling systems.

ASTM E 741-83 Standard Test Method for Determining Air-Leakage Rate by Tracer Dilution: A method for determining air change rate in buildings under natural meteorological conditions by tracer gas dilution.

Tracer Gas Infiltration Test Method: A method for determining the air change rates in a house by tracer gas dilution.

2.4.3 Site Detection

ASTM E 1186-87 Standard Practices for Air-Leakage Site Detection in Building Envelopes: Practices for locating air leakage in building envelopes. The practices are for qualitative measurements and not for determining quantitative leakage rates. The techniques include combined building depressurization and infrared scanning, building pressurization and smoke tracers, building depressurization and air-flow measurements devices, generated sound and sound detection to locate air-leakage sites, and detection of tracer gas concentration after adding tracer gas upstream of the leakage site.

2.5 Indoor Radon

Indoor Radon and Radon Decay Product Measurement Protocols, EPA-520/1-89-009, NTIS PB89-224273, U.S. Environmental Protection Agency, Washington, D.C.: This document contains indoor radon measurement protocols by several commonly used techniques. The methods most suitable for use in FRRP projects are Protocols 2.1 (Continuous Radon Monitor), 2.2 (Alpha-Track Detector), 2.3 (Electret Ion Chamber), 2.4 (Charcoal Canisters), and 2.8 (Grab Sampling). Other radon and decay product methods are also included which are less likely to be applicable to the project. The protocols describe sampler deployment, operation, calculations, and quality assurance. An introductory section covers screening measurements and deployment strategy. Due to the length of this document, it is incorporated by reference.

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The complete report, entitled "Standard Measurement Protocols, Florida Radon Research Program" (Order No. PB92-115 294; Cost: $26.00, subject to change) will be available only from:
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