ENHANCING SSD WITH DRAIN TILE: A MITIGATION DEMONSTRATION

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ABSTRACT

A homeowner unable to solve his radon problem gave The Illinois Department of Nuclear Safety (IDNS) the opportunity to demonstrate an unusual mitigation technique, enhancing sub-slab depressurization (SSD) with drain tile. The two-story house, originally built in 1856, was remodeled by the current owner and has many structural features that make the home difficult to mitigate. Use of drain tile-enhanced SSD, rather than numerous suction points, eliminated the homeowner's radon problem and kept radon piping to a minimum. While this technique is not necessary for many homes, it is a viable alternative in homes that are difficult to mitigate.

HISTORY

On October 19, 1995, the homeowner tested and found elevated radon levels of about 20 picocuries per liter of air (pCi/L) in his basement. After attempting mitigation and finding increased radon levels, he called IDNS for assistance.

IDNS radon program staff performed measurements throughout the house from November 6 - 13, 1995. The basement level of 20 pCi/L was confirmed. IDNS also found radon levels of approximately 11 pCi/L on the first floor and 14 pCi/L on the second floor. Testing was performed using electrets.

AN INVITATION TO BID AND OBSERVE

U.S. Environmental Protection Agency (USEPA) Radon Contractor Proficiency Program (RCP-listed) contractors located in Illinois were invited to bid on and/or observe the mitigation. Attendance at both the walk-through on December 20, 1995, and the mitigation on April 1, 1996, was on a first-come/first-served basis.

The two-story house, originally built in 1856, has been remodeled by the current owner. A few of the structural features that contribute to the mitigation difficulties include: a granite fireplace on the first floor; kitchen and basement stairs that are built over an unused cistern which was filled with sand and sealed by the homeowner with approximately eight inches of concrete; and a partially hand dug basement that has granite foundation walls. (See Figure 1) The hand-dug basement abuts a short (16-inch) crawl-space that extends beneath the kitchen. The newer basement section houses the washer/dryer, furnace, and household storage.

All bidders agreed that the radon problem originated from entry routes in the porous concrete, cracks, openings and penetrations throughout the slab. Convective and diffusive movements are the driving forces for radon entry. The house's balloon construction also contributed to the stack effect.

Three proposals were received and reviewed by the January 9, 1996, deadline. The Elliott & Associates bid was accepted and featured:

- installation of a sub-slab depressurization system in the basement;
- use of perforated drain tile beneath the basement floor;
- connecting the crawlspace beneath the kitchen to the mitigation system; and
- a five-year warranty.

The cost of the system installation was $3131.

Three RCP contractors observed the mitigation demonstration: BFS Environmentals (Long Grove, IL) represented by Nick Nicholas; Quality Aire Division of Babbs (Heyworth, IL) represented by Dora and Jerry Babb; and Geological Testing (Towanda, IL) represented by Tom Shickel.

MITIGATION PROCESS

Elliott & Associates found that the village of Mokena required no permits for mitigation. The Friday before the mitigation (March 29, 1996) Elliott & Associates completed pre-mitigation placement of the electrical wiring for the fan and drilled a hole for the vent pipe installation.

On April 1, 1996, Elliott Wall and his associate, Ken Coffey, arrived at the residence about 7:30 a.m. They draped plastic in the basement to protect the homeowner's stored items and set up the filtration system with a HEPA filter. Observers arrived about 9:30 a.m.

The mitigation was performed in two phases. Phase I included concrete removal and drain tile placement. Phase II included installation of the piping and fan.

Concrete flooring was removed in a 1-foot by 40-foot section that extended from the northeast corner of the basement, at the location of the suction pit, angling south through the hand-dug basement, terminating at its south wall.

The concrete was cut with a wet saw. This cutting technique incorporates a vacuum so that very little concrete dust gets into the air.

After removal of the concrete section, Mr. Wall hand-excavated the compacted soil to a depth of about 1-foot. He used a pick-ax to loosen the soil, then shoveled the soil onto the basement floor. The hand excavation was the most time-consuming part of the mitigation procedure.

Four-inch perforated drain tile was placed in the trench and connected to the suction pipe. Visquine plastic covered the drain tile. Pea gravel and extra drain tile were placed over the visquine to fill the void. Excess soil and concrete debris were removed. Replacement concrete was poured and finished.

The crawl-space beneath the kitchen was connected to the mitigation system with 2-inch PVC pipe inserted into the crawlspace. Three-inch PVC pipe was used to connect the crawlspace to the suction pipe.

Outside, the fan is connected to 3-inch vent pipe that extends above the roof ridge. A U-tube manometer serves as a system operational indicator.

POST-MITIGATION MEASUREMENTS

IDNS placed post-mitigation measurement detectors on April 15, 1996. The results revealed radon levels of less than 1.0 pCi/L throughout the house.

Use of drain tile-enhanced SSD, rather than numerous suction points, eliminated this homeowner's radon problem and kept basement piping to a minimum. It is not for every home, but drain tile enhancement provides a viable mitigation technique for houses that are difficult to mitigate.

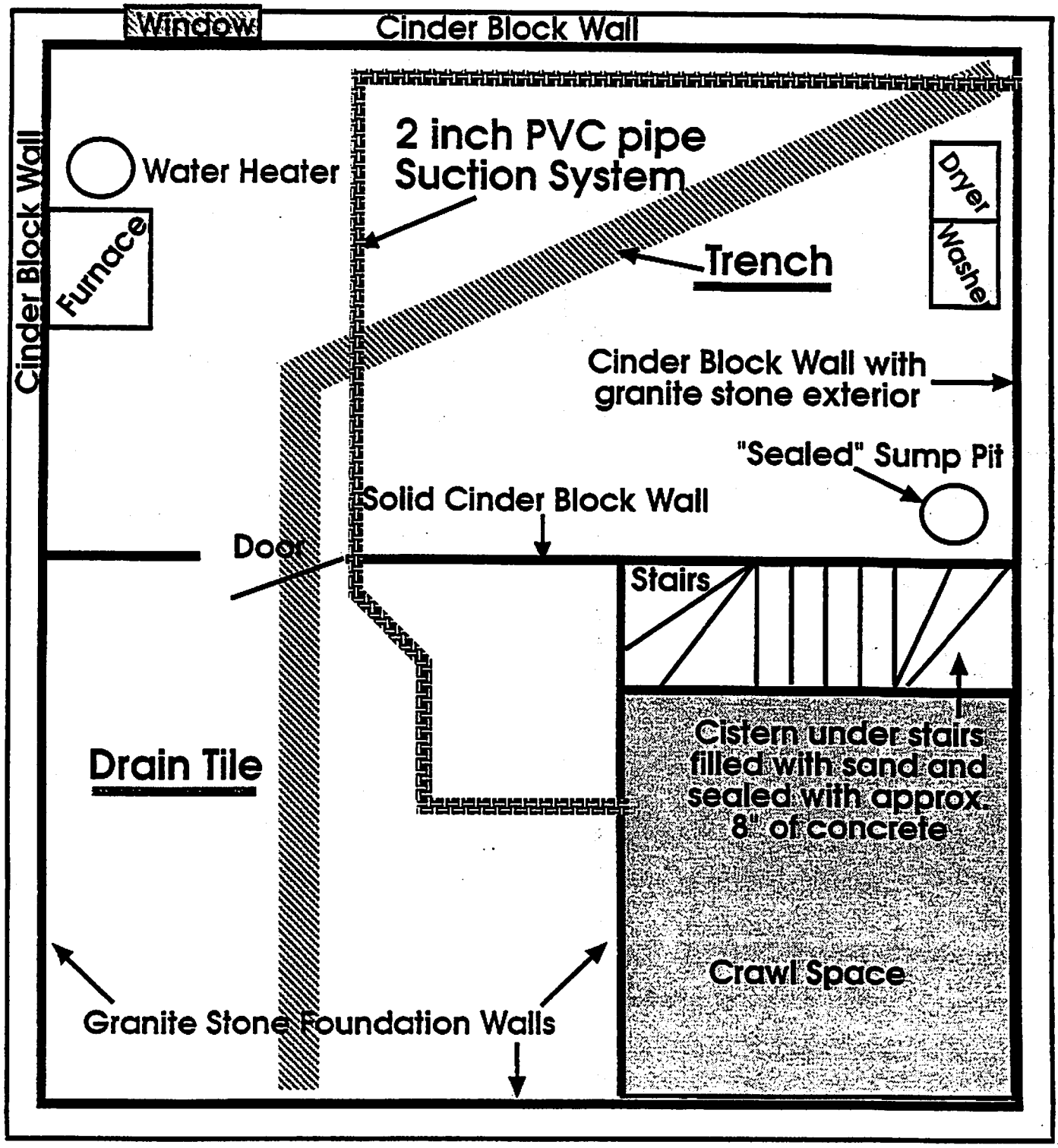

Fig. 1