4215

COMMERCIAL APPLICATIONS OF RADON MITIGATION TECHNIQUES

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ABSTRACT

Whether it be on schools or office buildings, very little commercial building mitigation work has been performed thus far on a regional or national basis. But just as residential mitigation has become commonplace, commercial building mitigation will become routine in the near future. In dealing with existing commercial buildings or with commercial buildings under construction, new mitigation techniques will be evolving, as will the retrofitting of residential techniques for commercial application. The following presentation is the result of a recent commercial mitigation in New Jersey.

INTRODUCTION

In March 1987 a large corporation conducted its own Working Level (WL) measurements at one of its facilities in northern New Jersey. The daughter measurements were made over a 24-hour period using Working Level (WL) monitors. Two measurements were made, each in the lower level of the building with a lab area registering .069 WL and an office area measuring .083 WL. At these levels, corporate management felt it needed to undertake remediation, which it initially performed itself. Remediation consisted of sealing all floor cracks, sealing the perimeter wall/slab joint, and painting the block walls. Retesting indicated no change in radon levels, so the company felt the need to call in a professional radon remediation company. The building was examined in September 1987. After a walkthrough of the facility, additional testing and a diagnostic evaluation were recommended. These were performed in late December 1987.

The Building

A two-story building, partially built into a bank, the building was constructed of 12 in concrete block and was completed in 1955. The building was 118 ft long and 36 ft wide. It had 6600 ft² of interior space, the lower level being a lab area having been altered many times, and the upper level being office space. There was also a 1500 ft slab-on-grade conference room. There was no central forced heating or air-conditioning, the heating being baseboard radiation and the air-conditioning consisting of window units. In the lab areas there were no fume hoods. (See Diagram 1.)

Retesting

Retesting consisted of testing every lower-level room with charcoal canisters, as well as the first floor slab-on-grade conference room. Exposure time for the charcoal canisters was four days, with testing being performed in December. These results are as follows:

Location	*Original Reading*
Lab I	51.6 pCi/L
Lab II	40.8 pCi/L
Lab III	36.6 pCi/L
Furnace Room	23.1 pCi/L
Generator Room	36.1 pCi/L
1st Floor Conf. Room	22.1 pCi/L

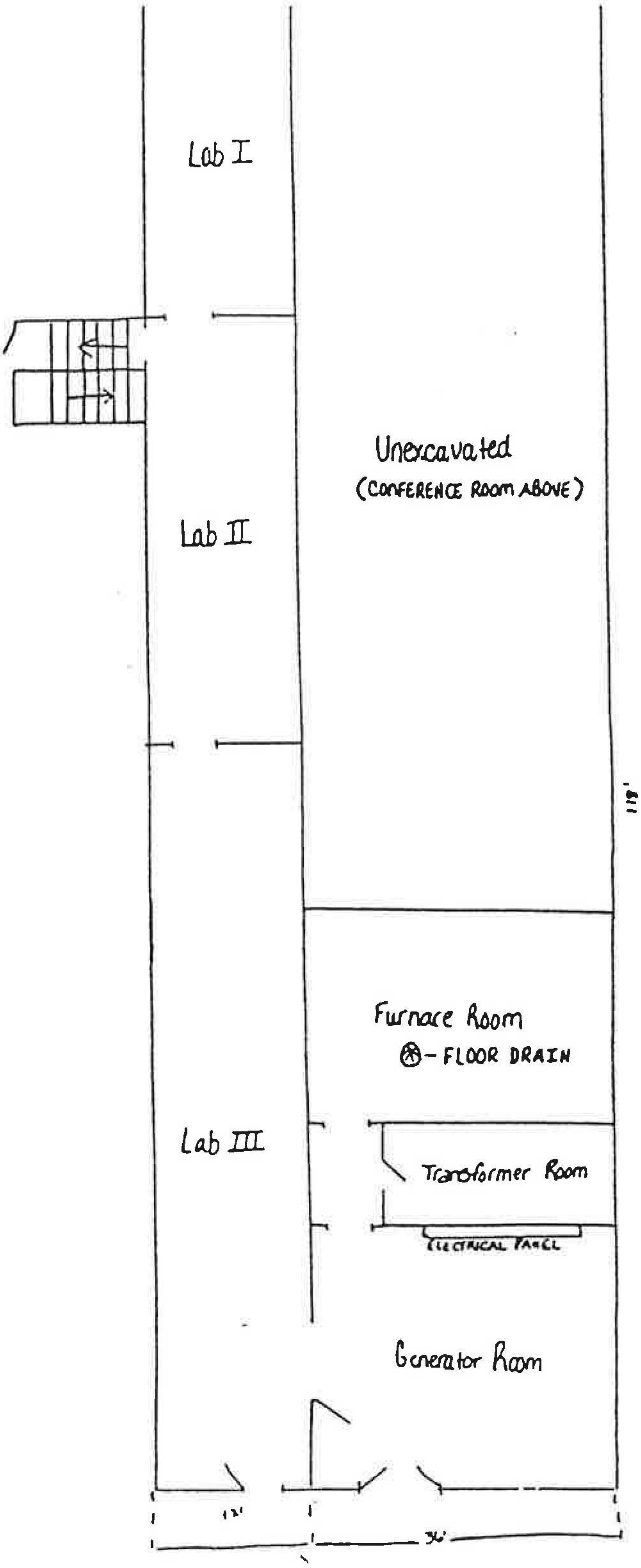

Diagram 1

When these measurements were seen, a thorough diagnostic investigation was begun.

Diagnostic Measurements

A visual examination of wall entry routes revealed numerous pipe openings and penetrations in the block, open pipe sleeves to the exterior ground, openings around electrical conduits, and openings around an air shaft duct.

Slab entry routes were minimal except for a floor drain in the furnace room that emptied into a dry well. Here, a grab air measurement was performed which indicated more than 1000 pCi/L. There was also a condensate line emptying into a large open drain pipe.

A number of sub-slab gas samples were collected. These were obtained by drilling a 3/8 in hole through the slab, after which gas was drawn into a cell and analyzed. This is a standard diagnostic technique.

Communication tests were performed in many areas of the slab, but communication was almost non-existent. Freon, being used as a tracer gas, was also injected with little or no transmission under the slab. Maintenance personnel said this was due to large 3 ft by 3 ft sub-slab piers that were poured for heavy equipment to rest on, which caused interference with communication and subsequent pressure field development.

Gas samples were also taken from cavities inside the painted block walls and ranged from 25 to 1200 pCi/L.

Conclusions for Selection of Mitigation Techniques

Because a pressure field could not be developed, it was decided that remediation would have to be through wall ventilation. Channel venting initially was considered; however, there was a considerable amount of large research equipment obstructing the path that could not be disturbed. The only alternative was block wall ventilation on a large scale. Reservations were expressed with this technique because it was a two-story block building. Wall communication tests were performed with vacuum suction and smoke and adequate communication was found in all walls, which was surprising because the wall expanse was so large. Using a rheostat on the vacuum, suction was adjusted for 2 in of water but, at this pressure, communication was poor. This was especially noticeable when the P measurement at 2 in of water dropped off by a factor of 20 in 25 ft (to .1 in water). It was therefore decided that, to achieve better communication, the area of the block from which suction was to be drawn would have to be cut back.

Remediation, therefore, began with hiring a foam insulation contractor to foam the course of block 7 ft from the floor around the entire exterior of the building, as well as the center interior partition. All block cores were drilled, but a mistake was made which was discovered afterward—not drilling and foaming the 1/2 cores at the ends of the block where the mortar joints were.

After the foaming was completed, all other entry routes were sealed, including jackhammering out the floor drain and installing an airtight trap. Communication tests were then performed using a micromanometer and it was discovered that communication was improved by a factor of 2. This then led the team to design the appropriate number of suction points and fans needed. (See Diagram 2.) Communication tests above the foam line also indicated that there was some leakage of the system, which indicated that the 1/2 cores at the mortar joint had not been foamed. Cost, however, pre-

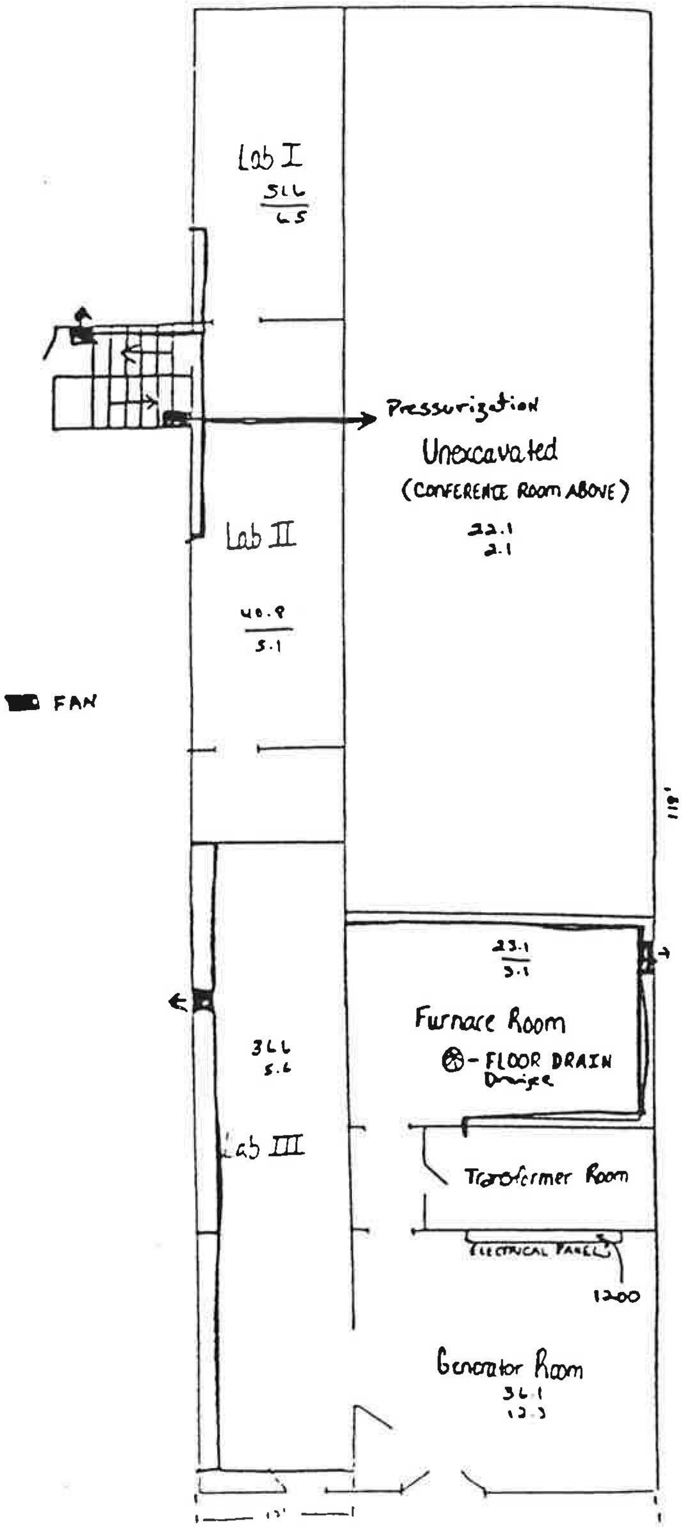

Diagram 2

Shows 3 blockwall suction systems and 1 pressurization system.

Numbers indicate radon levels (in pCi/L) prior to and after remediation.

vented this from being done. It was decided to install three wall depressurization systems and, as an experiment, a pressurization system was installed for the area under the conference room slab. From the building investigation, it was apparent that openings through the conference room slab were all sealed. If the pressurization system did not work, the second alternative was depressurization. It was hoped that the space could be pressurized with about 10 pascals. Using a micromanometer and a rheostat on the fan, levels were obtained that fluctuated between 8 and 15 pascals on a regular basis.

After the systems were operational, the areas were retested with charcoal canisters. This testing took place in March with the following results:

Location	*Reading with System*
Lab I	6.5 pCi/L
Lab II	5.1 pCi/L
Lab III	5.6 pCi/L
Furnace Room	3.1 pCi/L
Generator Room	12.3 pCi/L
1st Floor Conf. Room	2.1 pCi/L

Why were the levels in the generator room not significantly reduced? A full diagnostic work-up was performed again, which included freon tests, suction tests of the wall with smoke, gas samples from the walls, etc. What was interesting was that none of the walls had any significant radon levels. Gas samples then were taken from the electrical conduits in the room and it was found that there were more than 1200 pCi/L coming from the open conduits in the electrical panel boxes. These were then sealed with a one-part urethane foam. The final testing is not available at this time, but all rooms were expected to be below the EPA guidelines of 4 pCi/L.

Energy Considerations

The four in-line fans that were installed in this project were 1.8 amps (198 W). The life expectancy as per the manufacturer is 10 to 12 years. At 1 in static pressure, each fan will consume 82 W per day, or 718 kW per year. At a national average of $.05 per kW, the yearly cost would be $35.92 per fan.

Mitigation Costs to Consumer

All testing, diagnostic evaluations, and subsequent remediation cost the consumer $21,000. The foam insulation work cost the contractor $2400. The four systems that were installed as well as the sealing process took five men five days. Diagnostic time spent investigating the problem was about two days for two men.

So What Was Learned?

1. In some cases, residential remediation techniques can be applied to commercial buildings.
2. Foaming courses of block is an expensive procedure but, if done properly, can be very effective.
3. Large inaccessible areas can be successfully mitigated with pressurization.
4. Even the best-laid plans of experienced mitigators can be undone if a source is missed and the problem is not totally diagnosed.

CONCLUSION

Not all non-residential buildings will call for these techniques. Recently, an extensive mitigation was performed on four schools in which mitigation was successful but took a totally different approach. Commercial mitigation is going to be the new frontier of radon and the next few years should prove quite exciting.

GLOSSARY

1. Working Level (WL) measurements—a unit of measurement for documenting exposure to radon decay products. 1 Working Level is equal to about 200 pCi/L.
2. Communication Tests—communication tests are used to determine the ease or difficulty with which gas can move through the soil and aggregate under the slab or within a cavity such as a block wall. Typically two holes are drilled 20 ft apart and suction applied to one hole while micromanometer measurements are made at the other.
3. Pressure field development—refers to suction points located in the slab or wall that have the ability of drawing and maintaining suction at other various points remote from the suction point.
4. Channel Venting—a sheetmetal baseboard duct is installed around the entire perimeter of the basement (including interior block walls) and covers the joint between the floor and wall. Holes are drilled through the interior face of the block at intervals inside this baseboard, and the wall is ventilated by depressurizing the baseboard duct with fans.