ELLiot Lake Technical Note No. 12

Concrete Block Basements
Remedial Action Evaluation Program

DSMA ATCON LTD.
Acres Consulting Services Limited

December 1979
DSMA Report 'No. 1095/1075
"The Atomic Energy Control Board is not responsible for the accuracy of the statements made or opinions expressed in this publication and neither the Board nor the author(s) assume(s) liability with respect to any damage or loss incurred as a result of the use made of the information contained in this publication."
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2. OUTLINE OF REMEDIAL MEASURES</td>
<td>1</td>
</tr>
<tr>
<td>3. DISCUSSION OF REMEDIAL MEASURES</td>
<td>1</td>
</tr>
<tr>
<td>3.1 Filling Block Cavities</td>
<td>1</td>
</tr>
<tr>
<td>3.2 Sealing Exterior Wall</td>
<td>2</td>
</tr>
<tr>
<td>3.3 New Basement</td>
<td>3</td>
</tr>
<tr>
<td>3.4 Subfloor Ventilation System</td>
<td>3</td>
</tr>
<tr>
<td>4. ADDITIONAL WORK REQUIRED</td>
<td>3</td>
</tr>
<tr>
<td>4.1 Wall Treatment</td>
<td>3</td>
</tr>
<tr>
<td>4.2 New Basement</td>
<td>4</td>
</tr>
<tr>
<td>4.3 Ventilation System</td>
<td>4</td>
</tr>
<tr>
<td>5. COMPARISON OF REMEDIAL MEASURES</td>
<td>4</td>
</tr>
<tr>
<td>6. FURTHER ACTION</td>
<td>5</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION**

   This report is to document the conclusions drawn from field tests of experimental remedial measures for concrete block walls, and to suggest future tests.

   Poured concrete basements allow radon to enter only through the wall/floor joint, cracks in the wall and floor, and through openings such as sump pits. Basements with concrete block walls have additional entry routes through openings in the joints between blocks, and cracks in the blocks themselves. Once soil gas gains entry to the block cavities, it can then enter the basement through any openings in the interior face of the wall or through the unsealed top of the basement wall.

2. **OUTLINE OF REMEDIAL MEASURES**

   If sealing common routes of entry, such as the wall/floor joint, fails to achieve an acceptable radon level, further measures to treat the concrete block wall are necessary.

   There are four basic types of treatment. Filling the cavities with grout, excavating and sealing the exterior wall, or replacing the entire basement with a poured concrete structure are three maintenance free solutions. A fourth solution is to ventilate the fill below the floor slab. This requires a fan which must remain in operation and be maintained or replaced as necessary.

3. **DISCUSSION OF REMEDIAL MEASURES**

3.1 **Filling Block Cavities**

   Filling the cavities with a grout would appear to be an easy solution to blocking the movement of soil gas through a wall. The method is basically simple. Holes are made in the row of concrete blocks above grade and grout is poured into the wall through the holes to above grade level.

   Field experience is that walls which have sufficient openings in them to require grouting as a remedial measure are difficult to grout for that very reason. Grout will flaw from any opening in the inner face of the wall, so preparation is required to patch all obvious cracks and holes.
However, there are often concealed openings behind wing walls, around service entries, pipe openings, and chimneys, and portions of the mortar can suddenly fail under the pressure of the grout, releasing large volumes of grout before the hole can be closed. Over 30 gallons of grout was released in one such incident.

In addition, the grout contains considerable amounts of water. If the blocks are damp, as is likely to be the case if the wall is cracked, the wall cannot absorb this water, and water weeps from all the joints and from the block faces. The maximum to date was 26 gallons from a 24 foot length of wall.

The leakage of grout and the seepage of water from the walls mean that it is not possible to grout a finished basement without damaging the finish. The walls and floor must be exposed during the grouting procedure.

Additional work at the wall-floor joint may still be required even after the wall is successfully filled with grout, for the vertical mortar joints in the lowest course of blocks may be sufficiently porous to allow significant amounts of soil gas to enter the basement by passing through the gaps between the blocks in the bottom course.

The average cost of filling the blocks alone is $7,000 per basement.

3.2 Sealing Exterior Wall

Most houses in Elliot Lake have 5 to 6 feet of wall below grade. The space between the wall and the excavation is supposed to be filled with granular material over the weeping tile, followed by selected fill or further granular material to near grade.

It would thus appear to be a simple matter to excavate a trench around a house, expose the basement wall and then cover it and the upper surface of the footing with a material which would prevent the entry of soil gas.

Unfortunately, many houses do not have weeping tile, nor granular fill, and there is often no selected fill. Instead there is "random rock fill". This material contains broken rock and boulders, up to 5 tons in weight, often resting against the house walls. This makes excavation very
difficult, and hazardous for the crews.

Even when the exterior wall surface is sealed, further work will usually be necessary to close off routes to the interior through cracks in the footing, the wall/floor joint, and porous vertical mortar joints. The minimum cost of excavation, sealing, and restoration of landscaping is $10,000.

3.3 **New Basement**

Raising the house, and replacement of the old basement with a new poured concrete basement would seem to be a final, but expensive solution. It may be an economic solution for basements in poor structural condition, or located on rock. However, it is not possible to replace basements for buildings that are split level, or where the basement walls extend above suspended floors.

The minimum cost estimated for this is $15,000. The cost may be much higher if difficult excavation conditions are encountered.

3.4 **Subfloor Ventilation System**

Depending on the subfloor fill conditions, the minimum system could consist of a vertical pipe inserted through the floor slab, and led to an exterior air mover. If the fill is not as porous as normal, then additional work will be required to add header pipes below the floor slab and to close the openings in the floor. The simplest system has been installed in one house, and found to be effective with both a fan and a cowl.

The minimum cost estimated for this is about $1,000, with an upper limit of about $4,000 - $5,000 for the case where extensive header piping has to be laid in a finished basement.

4. **ADDITIONAL WORK REQUIRED**

4.1 **Wall Treatment**

Treatment of the walls alone will not make a basement gas tight. Additional work and money will be required on the floor slab, and the wall/floor joint. In the case of sealing the outer wall surface, it may also be necessary to grout the lower course of blocks to prevent gas entry through cracked footings.
The cost of this additional work may be as high as $15,000 if extensive work has to be carried out in a finished basement, resulting in high restoration costs.

In the case of filled block walls, it is either necessary to fill them with grout to above grade, or to waterproof them from above grade to the grout line, or else surface water will enter the wall at grade level, run down inside the block cavities, and run out of the wall when it reaches the filled blocks. Considerable amounts of water can enter block walls undetected until filling the lower courses prevents it draining away at the footing.

4.2 New Basement

If the new basement is properly built, no further work would be required.

4.3 Ventilation System

After installation of the vent pipe and air extractor, the floor slab cracks and openings, and the wall/floor joint must be closed. The cost of this additional work would average $3,000, estimating from the cost of similar work in concrete basements.

If a fan is used, it may be possible to limit the amount of extra work required by using a larger fan.

Maintenance and running costs for the system are extra, regardless of the type of air mover. Cowls and fans are similar in price, and it is possible that cowls may not last as long as fans.

5. COMPARISON OF REMEDIAL MEASURES

The methods fall into two categories:

(a) The passive methods which will allow the AECB to complete remedial work prior to leaving the site without any necessity for follow-up, other than for monitoring.

(b) The subfloor ventilation system which will require some form of ongoing program to ensure continued operation.
The ventilation method has the following advantages. It is cheap and simple to install, costing as little as 15% of the cheapest passive remedial measure. It can be installed in houses with finished basements with a minimum of disruption.

The disadvantages are the system may not work without a powered fan, and home owners may not be willing to have a fan installed, for this will indicate that their house has a radon problem. Resale may be more difficult. Long-term maintenance of the air mover is required. If an electric fan is used the home owner may turn the fan off, and there is a continuing expense for power.

6. **FURTHER ACTION**

A number of houses with block basement walls will have subfloor ventilation systems installed on an experimental basis. This will show if the initial success of this method is generally valid.

Ventilation of the block wall cavities by holes drilled through from the outside above grade was tried before, but the results were inconclusive due to high exterior radon. This will be tried again at a more suitable house.

Applying suction to the weeping tile may be equivalent to installing a subfloor ventilation system in a block basement. This will be investigated at suitable houses.

The methods and equipment for grouting will be refined by further field trials to reduce the cost.

Ventilation methods will be investigated to see if they are effective in cases where the basements have water problems. This may eliminate the necessity of dealing with water entry to allow sealing.