Design and Performance of Aerated Floor Systems

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Abstract: Aerated floor systems were incorporated into the design of several newly constructed buildings, including two homes in the Southwest and a community center in the Rocky Mountain region, to provide an under-slab void network that could be vented for vapor intrusion control. Compared to a conventional slab on grade liner and granular venting layer designs, the aerated floor system was selected to allow more efficient movement of ventilation air, increasing the potential for passive air flows to adequately dilute sub-slab gas concentrations and protect indoor air. Passive mitigation avoids electrical and other operation and maintenance costs associated with electric fans (active systems), resulting in a more sustainable and “green” remediation system. Air flow and pressure measurements were taken at these sites to determine how well the aerated flooring system performed under normal and wind pressure gradients, induced gradients using whirlybird fans, solar powered fans and using traditional radon blowers. Based on the data collected, wind-driven gradients can provide sufficient ventilation to dilute moderate sub-slab concentrations to predictable and acceptable levels with a reasonable number of riser pipes. The addition of a radon fan allowed depressurization of the under-slab void network and conversion to a mitigation system that could address higher concentration conditions.

Green building (also known as green construction or sustainable building) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.
an Aerated Floor System for

**Sustainable** - The word sustainability is derived from the Latin *sustinere* (tenere, to hold; sus, up). Dictionaries provide more than ten meanings for *sustain*, the main ones being to “maintain”, “support”, or “endure”. However, since the 1980s *sustainability* has been used more in the sense of human sustainability on planet Earth and this has resulted in the most widely quoted definition of sustainability and sustainable development.

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**2000 sq. ft. Residence in Las Vegas**

Modeling results of an aerated floor, which were consistent with the measured performance characteristics found at home built with an aerated floor (see below).

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The table above demonstrates the amount of concrete used over standard Cupolex forms compared to a 4" thick slab which consumes 0.1111 yd³/ft² and a 6" thick slab consumes 0.1667 yd³/ft².

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**Table: Concrete Consumption**

<table>
<thead>
<tr>
<th>Form Height</th>
<th>Void Space Under Form</th>
<th>Concrete Consumption on Form (yd³/sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.57</td>
<td>0.001</td>
</tr>
<tr>
<td>4</td>
<td>2.76</td>
<td>0.0017</td>
</tr>
<tr>
<td>5</td>
<td>4.33</td>
<td>0.0036</td>
</tr>
<tr>
<td>8</td>
<td>6.69</td>
<td>0.0043</td>
</tr>
<tr>
<td>10</td>
<td>8.66</td>
<td>0.0055</td>
</tr>
<tr>
<td>12</td>
<td>10.24</td>
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<td>22.83</td>
<td>0.0090</td>
</tr>
<tr>
<td>28</td>
<td>24.8</td>
<td>0.0095</td>
</tr>
</tbody>
</table>

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**Passive Performance**

- *SP1* indicates radon fan data excluded from graph.
Vapor Intrusion Mitigation

9000+ sq. ft. Commercial building in Cheyenne, WY

Pressure differential measurements vary and can be easily overcome with a wind driven whirlybird vent, a solar powered vent or by adding an electrical radon fan. The addition of an electric fan would not meet the passive design criteria but may be necessary if the sub-slab concentration are too high or the slab seals into the building create a preferential pathway. Nevertheless, much smaller and fewer fans can be used to mitigate an aerated floor void, compared to traditional sand and gravel venting layers. A number of slab seals were required at the above referenced building (for reasons not related to the aerated floor system), but any leakage may have had a positive effect by providing additional dilution air, reducing the sub-slab concentrations to low levels compared to the expected concentrations, which were in the several thousand micrograms per cubic meter range (based on groundwater concentrations).
Projects

Conclusions

• Passive venting of aerated floor venting systems is achievable.
• Air moves efficiently through aerated floor systems, allowing dilution of sub-slab gases.
• Aerated floor systems have the ability to transfer pressure differentials across the slab with little to no reduction of vacuum level.
• Slab penetrations may not have a significant adverse impact on aerated floor systems due to efficient air movement and dilution.
• For sustainable and green buildings an aerated floor using the Cupolex can reduce the carbon footprint of a building.
• When electric fans are needed for high concentrations of vapors, large areas of aerated floor systems can be depressurized with small fans, reducing the number of suction points, riser pipes, and electrical costs.