CUPOLEX® Aerated Floors vs. Barriers

David J. Folkes, PE, *EnviroGroup Limited*

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ABSTRACT

There are three general approaches for controlling vapor intrusion into buildings: 1) through the use of barriers, 2) ventilation or dilution of sub-slab vapors, and
3) sub-slab depressurization. The first technique relies on a robust barrier to prevent vapors from entering the building, such as a spray-on asphaltic membrane or HDPE placed below a conventional floor slab. The other two approaches rely on dilution or diversion of vapors and only require a floor slab of reasonable integrity to function effectively, particularly with the highly efficient sub-slab void spaces provided by aerated floors, as described below.

BARRIERS

Barriers control vapor intrusion much like a dam, by physically preventing flow of air or diffusion of vapors through any openings in the floor. This is most commonly achieved by placing membranes below the floor slab to seal any cracks or openings that may subsequently exist in the overlying concrete. Barriers, however, like dams, can cause vapor concentrations and pressures (in the case of methane) to build up over time. Fortunately, this build up in concentration and/or pressure also promotes the lateral migration of the vapors toward areas of lower pressure or concentration, such as riser pipes or vents installed to exhaust the vapors to the outdoor air. Perforated pipe is often placed in sand and gravel "venting" layers below the barrier to make it easier for the vapors to migrate to exhaust points.

VENTILATION OR DILUTION

Vapor intrusion can also be controlled by diverting or diluting rather than blocking the flow of vapors. This would be similar in concept to a diversion ditch that channels water around a structure, as opposed to a dam that simply attempts to stop the flow of water. With the ventilation approach, outdoor air is allowed to flow under the floor slab through a venting layer, diluting the concentration of the vapors and sweeping them out through exhaust points. The floor slab must have sufficient integrity to allow efficient flow of air through the venting layer, but an additional membrane serves little purpose if the vapors below the slab are diluted to safe levels. In other words, the small amount of air that might come up through cracks in the floor is at a concentration that would have no impact on indoor air. Ventilation also prevents build up of vapor pressures, further limiting the potential for even low concentrations of vapor to enter the building. While venting layers can be constructed from sand and gravel (as described for barrier systems, above), the open void space below a Cupolex® aerated floor is much easier to vent, particularly if the rate of air flow is controlled by fans.

SUB-SLAB DEPRESSURIZATION

The third technique for controlling vapor intrusion is called sub-slab depressurization, or SSD. This approach is similar to ventilation, because it relies on the movement of air to divert, rather than block the movement of soil vapors. But rather than relying solely on dilution (although significant dilution of vapors typically still occurs with SSD), SSD systems are designed to lower the air pressure below the slab so that air flows <u>down</u> through any cracks or penetrations in the slab, rather than <u>up</u> into the building. The technique was originally developed to control radon intrusion into existing buildings, where it is generally not practicable to install membranes after the fact, and where slabs are typically cracked and imperfect. Therefore, no membrane is required for SSD to function in new buildings, particularly with high quality floor slabs. Further, SSD has been demonstrated to be very effective in the vast majority of existing buildings, even without a permeable venting layer below the slab (e.g., EPA, 1994). Once again, SSD systems can effectively depressurize soils below the slabs of existing buildings and prevent vapor intrusion. However, with the open void space below a Cupolex® aerated floor, SSD is even more efficient and reliable; simple post-construction pressure tests can demonstrate that all portions of the building are effectively depressurized and protected.

It may be noted that a membrane can enhance the efficiency of SSD systems consisting of conventional slabs over soil venting layers, because too many cracks can limit the extent to which a single suction point can depressurize a slab, requiring more suction points and perhaps larger fans. The open void below aerated floors like Cupolex®, however, are so easily depressurized that typical cracks will not provide enough air flow to compete with the flow of air through the void. In either case, an effective SSD can be installed without the need for a membrane by simply installing sufficient suction points and fans.

CONCLUSION

While membranes are typically required for mitigation systems designed to function as barriers (essentially damming the flow of vapors), mitigation systems such as the Cupolex® aerated floor system that rely on ventilation or depressurization (diverting and diluting the vapors) do not require membranes. In fact, SSD systems were developed for installation in existing buildings where membranes could not be placed. Further, mitigation systems that result in the dilution of vapors below the floor and whose performance can be monitored and controlled (e.g., through fan operation and pressure measurements) have the advantage of not allowing vapor concentrations and pressures to build immediately below the building, which is not always the case with barrier systems.