

ventilation system. Vapor barrier membranes limit the advection and diffusion of VOCs while the passive ventilation system depressurizes the soil vapor below the membrane.

The system will consist of, from top to bottom, a concrete slab, minimum ~~1530~~ mil vapor barrier (e.g., Stego Wrap®), vapor collection layer (4-inch minimum aggregate or geocomposite), and 4-inch diameter, perforated vapor extraction pipes or strip composite (horizontal pipes). The walls of below-grade structures will have a minimum ~~1530~~ mil vapor barrier between the concrete walls and subgrade soil (Figure 18). Cushion geotextiles and/or 2-inches of sand will be placed to protect the vapor barrier from puncture.

Horizontal pipes will be spaced generally every 50 to 60-ft in either a gravel-filled trench, the vapor collection layer, or immediately above the subgrade as strip composite. The horizontal pipes will be connected to 4-in diameter, solid vertical vapor ventilation pipes (vent pipes). Vent pipes will extend vertically through the below-grade structure and ventilate a minimum of 10-ft above grade and a minimum of 10-ft from any air inlet and/or operable door or window. Ventilation pipes will be provided at a frequency of 1 per 10,000 square feet (sf) or a minimum of 4 per continuous, below-grade structure. A monitoring point (e.g., labcock valve or similar) will be installed within each vent riser.

The system will be designed to operate actively, e.g., head losses will be evaluated and blowers specified; however, it will operated passively upon initial start-up. Vapors will be extracted from the vapor collection layer due to natural changes in barometric pressure as well as changes in temperature within the building resulting in vapor rise through the vent riser. To enhance the passive extraction, a wind-driven turbine will be added to select vent risers. If an active system is identified for the Site without a passive option or a more robust membrane system (e.g., Liquid Boot Plus®) is specified, alternative pipe diameters and spacing may be specified.

### **7.2.2 At-Grade Occupied, Enclosed Structures**

At-grade occupied, enclosed structures may consist of lobbies, elevators, or commercial space. Engineering controls for at-grade occupied, enclosed structures will consist of aerated floors such as Cupolex®.

The aerated floor system will consist of, from top to bottom, a concrete slab, aerated forms, and prepared subgrade (Figure 18). The void space beneath the structures will be connected to vent pipes. Vent pipes will ventilate a minimum of 10-ft above grade and a minimum of 10-ft from any air inlet and/or operable door or window. A minimum of 2