AERATED FLOOR VOID SPACE SYSTEMS TECHNOLOGY INFORMATION SHEET

A component of vapor intrusion mitigation

This Interstate Technology & Regulatory Council technology information sheet provides a general description of aerated floor void space systems (VSS) and their use as a vapor intrusion (VI) mitigation method. Aerated floor VSS are a design component for sub-slab ventilation (SSV) or sub-slab depressurization (SSD) systems and can be operated in either active or passive venting mode. This technology information sheet includes an overview of the aerated floor VSS, conditions for applicability as a VI mitigation method, and advantages and limitations of using aerated floor VSS. Cost considerations and a list of additional resources are also provided.

Overview

Aerated floor VSS are concrete slabs installed with a continuous void space under the slab that can be used for sub-slab venting or depressurization in lieu of the sand or gravel venting layer commonly associated with traditional mitigation systems. Because the void space has very low resistance to airflow, vacuum levels and air exchange rates in the void space are generally higher and more uniform than in sand or gravel layers. Aerated floors can be constructed in various ways, including open void spaces below structural slabs, but are most typically constructed using proprietary plastic forms that are placed on the subgrade prior to pouring of the concrete slab. Therefore, this technology information sheet will focus on proprietary concrete void-forming systems that create a void network below a slab.

Aerated floor VSS are most applicable to new construction, although aerated floors can also be used for complete floor replacement or placed over existing slabs if a higher finished floor elevation can be accommodated. Aerated floor VSS can be appropriate for residential, commercial, institutional, and industrial building designs.

Proprietary void forms typically shape the bottom of the concrete slab by creating a network of interconnected dome shapes. The slabs are typically supported at the points between the domes (i.e., where the concrete contacts the ground) but can also be designed to span between building foundation elements as a structural, post-tensioned slab. The forms vary in height from about 2 inches to 30 inches but are most commonly approximately 10 inches high. Welded-wire mesh is typically placed over the forms for reinforcement, and the concrete thickness above the top of the forms is typically 2.5–3 inches for residential buildings and 5–7 inches for commercial buildings. The slab thickness can be increased to support larger loads as necessary. The domes create an orthogonal grid of arches in the bottom surface of the slab that distributes loads and places the slab under compression; as a result, the volume of concrete is similar to, or may be less than, the volume of concrete required for a traditional flat slab with the same load capacity.

For VI mitigation, aerated floor VSS can be designed for SSV or SSD operation (in the former case, air inlets are typically provided to increase airflow rates) and operated in either active and passive venting modes, depending on the degree of venting or depressurization needed to mitigate VI. Long-term operation, maintenance, and monitoring costs can be lower than for traditional mitigation systems constructed with gravel venting layers because fewer and/or smaller fans are required to depressurize and/or vent the void space (in the case of active operation). In addition, the vacuum level in an aerated floor is often relatively uniform across the slab because of the limited resistance to airflow within the void space. This can result in fewer riser pipes, relative to an equivalent traditional (i.e., gravel) approach, to remove subsurface vapors. As a result, confirming and monitoring performance of aerated floor SSD systems can be simpler and less expensive than for SSD systems installed in gravel. Because aerated floor VSS allow air to directly contact the subgrade below slabs, this technology can enhance oxygen levels and may promote increased aerobic biodegradation of petroleum hydrocarbons.

Components

Aerated floor VSS are generally divided into the following components (Figure 1):

- Proprietary plastic forms (various types based on function)
- Concrete and reinforcement (placed over plastic forms, as required by structural design)
- Riser pipes, inlet pipes, and monitoring ports (as required by the venting design)
- Boots installed around all penetrations (similar to boots used for sheet membranes)
- Caulking/sealing of perimeter and control joints

Figure 1. Aerated floor void space system.

Source: Vapor Mitigation Sciences LLC, used with permission.

Advantages

Advantages of using aerated floor VSS for SSV and SSD include the following:

- Has higher airflow rates for SSV and more uniform vacuum levels for SSD than typical sand/gravel venting media.
- Has lower operating costs due to the very low resistance to airflow.
- Costs for system installation may be lower due to elimination of gravel layer, sub-slab gas collection pipes, and membrane (note: the costs for concrete, steel, and imported fill may also be reduced).
- Assembly and installation are relatively quick when compared with the time required for gravel and membrane placement.
- A single small (e.g., 20-watt) fan can typically provide a relatively uniform vacuum across relatively large areas.
- A separate vapor or moisture barrier is not required in most cases due to the presence of the void space and plastic forms combined with booting and sealing of penetrations through the floor and caulking of perimeter joints.
- Useful for mitigating existing buildings with high water table conditions that prevent depressurization under the existing floor slab.

Limitations

Limitations of using aerated floor VSS include the following:

- Less use and familiarity in the United States relative to other countries

- Less applicable to existing buildings, unless replacing the existing floor slab or placement over the existing floor slab is acceptable
- Might not be appropriate when vapor concentrations are high and/or the building is designed to be negatively pressurized (which may create difficulty in creating a sufficient sub-slab vacuum across the slab)
- May increase cost in some circumstances if additional site grading is required to accommodate the void form thickness
- Unfamiliar to many architects, engineers, regulators, and contractors

Cost Considerations

Cost considerations specific to aerated floor VSS include, but may not be limited to, the VSS slab design; the supply, delivery, and installation of the proprietary VSS forms; and the supply, delivery, and installation of the VI mitigation system components. The cost for sub-slab and riser pipes is typically lower than for traditional gravel mitigation systems, all else being equal. If the passive mitigation system is upgraded to active, the addition of fans would represent an extra cost. The cost for operation and maintenance would typically be lower than a traditional (gravel/membrane) system due to smaller or fewer fans. Typically, monitoring cost savings (per square foot of building area) will be greater as building size increases.

Occupant, Community, and Stakeholder Considerations

It is essential to develop and implement a site-specific community involvement plan that addresses how to win trust and gain access to properties, communicate risk to potentially exposed individuals, and minimize the disruption of people’s lives and businesses. For more details see **Chapter 3: Community Engagement**.