

PRESSURIZED PLENUM LEAKAGE

The following excerpt from the ASHRAE Underfloor Air Distribution (UFAD) Design Guide¹ describes some of the advantages of zero-pressure plenums over pressurized plenums.

4.1.1. Pressurized Plenum

In pressurized plenums, the central air handling unit (AHU) is controlled to maintain a small, but positive pressure in the underfloor plenum relative to the conditioned space. Typical plenum pressures fall in the range of 0.05 - 0.1 in. H₂O (12.5 - 25 Pa). To date, pressurized plenums have been the most commonly installed UFAD configuration. In most practical situations pressurized plenums can maintain a very constant plenum pressure across a single control zone [Bauman et al. 1999a]. This allows any passive diffuser of the same size and control setting (typical damper opening) located in the zone to deliver the same amount of air to the space. However, airflow performance can be impacted by uncontrolled air leakage and when floor panels are removed for access to the underfloor plenum. See Sections 4.2 and 4.3 for further discussion.

When the supply air flows freely through the underfloor plenum, heat exchange with the structural mass (concrete slab and raised floor panels) may influence supply temperature variations as a function of distance traveled through the plenum, as well as other thermal performance issues. These are discussed below in Section 4.4.

4.1.2. Zero-Pressure Plenum

In zero-pressure plenums, the central AHU delivers conditioned air to the underfloor plenum in much the same manner as with pressurized plenums, but in this case, the plenum is maintained at very nearly the same pressure as the conditioned space. Local fan-powered (active) supply outlets are required to supply the air into the occupied zone of the space. To date, several zero-pressure plenum designs have been installed, but they have not enjoyed the same amount of market penetration as pressurized systems.

In terms of airflow performance, fan-powered outlets provide improved control of the supply airflow rate compared to passive diffusers. Active diffusers are well-suited for task/ambient conditioning (TAC) system applications in which occupant control is a key design objective. The removal of floor panels in zero-pressure plenums will not impact airflow performance. Similarly, zero-pressure plenums pose no risk of uncontrolled air leakage to the conditioned space, adjacent zones, or outside.

The advantages of no leakage and improved local airflow control must be traded off against several factors. Fan-powered supply outlets may have a cost premium compared to passive diffusers used in pressurized plenum designs. In terms of energy use, although central fan energy consumption will be reduced compared to that for a pressurized plenum, this savings will be offset by the energy consumed by the large number of small local fans. However, if a pressurized plenum leaks at a high rate, this can also lead to excessive fan energy use. Another consideration with local fan-driven units is the possibility of increased noise levels, although underfloor systems are generally rated as being quieter than conventional overhead systems.

Zero-pressure plenums share many of the same thermal performance issues as pressurized plenums. See Section 4.4 for further discussion.

¹Bauman, F. 2003. *Underfloor Air Distribution (UFAD) Design Guide*. Atlanta: ASHRAE, pp. 56-57.