

## Underfloor Air Distribution

An underfloor air distribution system utilizes a plenum space between the structural slab and the underside of a raised floor to distribute the conditioned air to the space. An underfloor air distribution system creates a stratified condition where the natural buoyancy of air removes heat and contaminants from the occupied zone. Diffusers are located in the raised floor within the occupied zone to supply air to the space.

The raised floor is usually 3”-6” above the structural slab. Raised floors can also vary between 12”- 18” above the structural slab when the plenum space is also used for electrical and piping distribution.

The plenum of the underfloor air distribution system can be either a pressurized plenum or a zero-pressure plenum. A pressurized plenum delivers the air through the plenum and into the space through passive grills or diffusers. A zero-pressure plenum delivers the air into the space through local fan powered supply outlets. When installing a pressurized plenum the typical plenum pressure is between 12.5 -50 Pa. In order to control air leakage it is important to properly seal junctions between plenum partitions, slabs access panels, and exterior and interior permanent walls. A zero-pressure plenum is maintained near the same pressure as the conditioned space; due to this air leakage is not a problem with this type of plenum.

Since the diffusers are located in the floor the supply air temperatures must be warmer than the conventional overhead air distribution systems because of the immediate proximity of the supply air to the occupied zone. For cooling the supply air temperature should range from 63°F- 68°F, this temperature range will prevent overcooling the occupants of the space. If the slab is warmer than the plenum inlet temperature it can be assumed if there is a 5°F difference between the slab and inlet temperature then every 30ft the plenum air travels will result in a 2°F increase in air temperature.

In the pressurized plenum, there are three types of passive diffusers: swirl, constant velocity, and linear. Swirl floor diffusers are round and characterized by swirling air flow pattern of the supply air that rapidly mixes with the room air. The constant velocity floor diffusers are slotted squares that supply the air in a jet-type air flow pattern. Constant velocity diffusers are characterized by the occupants ability to adjust the direction of the of the supply jets. Linear floor diffusers supply air from the plenum through a jet type planar sheet with multiple blade dampers. The best placement for linear floor diffusers are in perimeter zones and because they are not designed for frequent adjustment by occupants.



Swirl Diffuser



Constant Velocity Diffuser



Linear Diffuser

In a zero-pressure plenum active diffusers, supply outlets that rely on a local fan, deliver air to the conditioned space. Most passive diffusers can be used as active diffuser by adding a fan powered outlet box to the under side of the diffuser.

The potential benefits of an underfloor air distribution system include improved air quality, decreased fan horsepower and economizer savings. In underfloor air distribution systems the contaminants are drawn to the ceiling which is outside the breathing zone. If underfloor air distribution and overhead VAV systems require the same supply airflow at design conditions, then the absence of supply ducts, terminals, and runouts in a pressurized-plenum reduces the external static pressure on the supply fan. The reduction in external static pressure results in the selection of a smaller motor, requiring less fan horsepower when compared to the VAV system. The higher supply air discharge temperature can lead to economizer savings.

### **References:**

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