TAF-R

APPLICATION GUIDE

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Titus

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Access floor air distribution is relatively new to the U.S. This Application Guide has been developed to answer questions on the design of access floor air distribution systems.

Please put the Application Guide in your new Application Guide Binder for future reference.

Access Floor Air Distribution

Properly designed access floor air supply systems take advantage of thermal stratification. The key is to have a diffuser that rapidly mixes air without penetrating the stratification layer at the ceiling. The Titus TAF-R provides a "twist and swirl" pattern which accomplishes this rapid mixing at a low pressure and noise level. Several combinations of temperature difference and supply air pressure can achieve this effect.

Underfloor Plenums

The raised floor office can be supplied with conditioned air from below the floor in two ways.

1. **Pressurized Plenums:** The pressurized plenum (the area between the slab and the raised floor) is essentially a large duct maintained at a constant pressure differential to the room above; typically between .05 and 0.10 in. pressure (w.g.). This pressure is maintained through the supply of conditioned air from a number of supply duct terminations. The spacing and location of these ducts are dependent on the air supply requirement and the plenum depth, with shallow plenums and/or high air quantities requiring more air supply duct outlets under the floor. Access floor diffusers are specially designed grilles with a user adjustable damper to regulate flow. Advantages of pressurized plenums include low first cost and easily changed layouts.

2. **Neutral Plenums:** With the neutral plenum design, the same layout as the pressurized plenum may be used, but the pressure difference between the plenum and the room is kept as close as possible to zero. Floor diffusers either contain integral fans, are ducted from a central source, or both. In many cases, these closely resemble conventional ceiling supply systems. Advantages include the possibility of multiple small zones (as with multiple tenants) and insensitivity to construction details. Disadvantages include higher first costs due to ducting and/or fan connections under the floor, lower flexibility as the grilles are individually ducted, and potentially higher noise levels.

Titus TAF-R is designed to be used in pressurized plenum access floor distribution systems. TITUS utilizes the pressurized plenum technique for its simplicity and lower first costs.

Plenum heights typically range from 12" to 24". Approximately 6", measured from the top of the floor panel down into the plenum, is required to install the TAF-R. The plenum height is usually determined by the height requirements of other equipment that will be located under the floor, not by the diffuser height. The number of inlets required to supply the plenum with sufficient air to run the diffusers is dependent upon the plenum size and the number of diffusers, which in turn is determined by the load of the space.

If zone control is desired from the underfloor plenum, the plenum can be partitioned into separate zones. The zones in the underfloor plenum should correspond to building zones having similar load requirements. However, it is not necessary to partition the underfloor plenum into zones and doing so can make future office layout changes more difficult. If an office layout must be changed, the partitioned plenum will need to be changed to match the new layout.

Because of the special heating and cooling requirements of the perimeter of the building, it may be necessary to create a perimeter zone in the underfloor plenum to run a separate perimeter system.

Perimeter Heating

Perimeter heating cannot be accomplished with the same system as the interior load cooling system. Separate ducting of hot or reheated air, hydronic systems, or perimeter fan powered systems should be employed to condition the skin load on the building.

Return Air

Due to the upward air flow, returns should be located at the ceiling or on a high side wall. This allows the heat from ceiling lights to be returned before it is able to mix with the conditioned air in the occupied zone. There will also be a small amount of "free cooling" due to the natural buoyancy of hot air.

If you are using 55oF supply air for humidity reasons, some of the return air can be recirculated from the ceiling to the underfloor plenum to raise the temperature of the air to 60oF to 65oF. With this type of system, you cannot accurately control the temperature of the air at the diffuser. You will also lose the access floor cost benefits of using warmer supply air, because the supply air is cooled to 55oF and then mixed with return air to obtain 65oF air.

Another option is to take the return air back to the air handling unit where it can be filtered and dehumidified before re-entering the underfloor plenum. With this option, you can more accurately control the air temperature at the diffuser and you gain the cost benefits of the warmer supply air temperature.

Humidity Issues

A potential problem with the higher supply temperatures used in underfloor supply systems is the higher potential moisture content of the 62oF to 66oF supply air most commonly used in these systems. The supply system must reduce relative humidities to less than 60% to meet IAQ concerns, and this requires dew points less than 65oF. This implies either reheat or blending of air to achieve a 65oF supply, 55oF dew point condition. System designs utilizing condenser water reheat, run-around coils, face & bypass, and other strategies can be employed to solve these potential design problems. Other possible solutions include the use of a separate system to dry outside air or the use of desiccant dehumidification.

Sizing Jobs

The optimum design point for the TAF-R is 80 - 100 CFM when a 10ºF room / supply differential is used. At this point, the noise is negligible and the pressure required is less than 0.10". Throw will be less than 6 ft., preserving the desired ceiling stratification layer. Our testing shows that there is 100% mixing in the occupied zone under these conditions. The stratification in this installation results in a supply - exhaust DT similar to the typical 18ºF to 20ºF ΔT common in most conventional systems.

For example, with 64ºF supply air in a 74ºF room, the room exhaust, at the ceiling, will probably be about 82ºF, for an 18ºF DT.

This means that one diffuser can handle:

18ºF ΔT
100 CFM
1.08
1944 BTUH of room load

OR

1944 BTUH
÷ 3.41
570 watts of internal heat

Lights are typically 0.75 W/SqFt, but with ceiling stratification are probably not a part of the room load (but are seen by the air handler). If computers and printers supply about 1W/SqFt load and occupants add about 1.2 W/SqFt, this translates to:

1.0 W/SqFt (computers and printers)
1.2 W/SqFt (occupants)
2.2 W/SqFt (room load)

This corresponds to one TAF-R every:

570 Watts of internal heat
÷2.2 W/SqFt room load
260 SqFt of floor space sensed interior zone load

As the TAF-R is easily relocated, little attention needs to be placed on diffuser location until the office furniture layout is finalized. As a general rule, one TAF-R should be provided for each occupant.

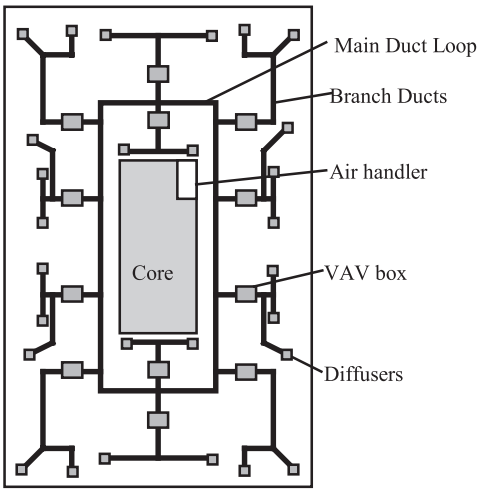
Thermal Storage

The use of the underfloor plenum as a supply duct allows the use of the thermal mass of the structure as an energy "flywheel". By ventilating the underfloor space with cool air at night, the structure can be cooled to the point where the load during the early part of the day is significantly lowered. A number of strategies can be employed to take advantage of the potential for stored "cool", resulting in lowered energy use and off-peak energy use.

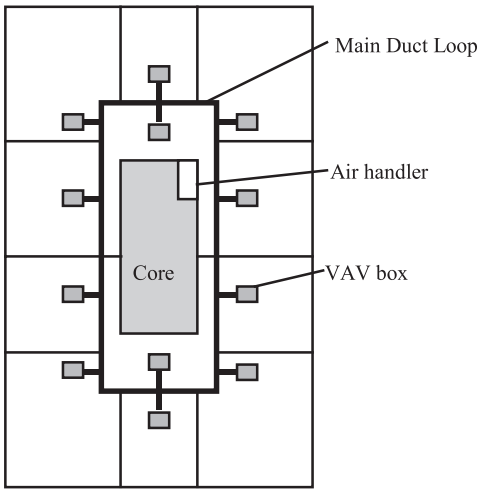
Cleanliness

The use of in-floor supply air diffusers offers a potential for contamination from the occupied zone. The TAF-R employs a catch basin as a part of the volume regulation system. This basin will hold approximately 5.5 FL OZ of liquid and should be cleaned as part of the regular maintenance system. If dirt does fall into the underfloor plenum it would not be entrained into the supply air because the velocities in the underfloor plenum are low. It is recommended that access floor diffusers be avoided in locations where there will be a high possibility of liquid contamination, such as laboratories, cooking areas, or other sensitive areas.

Comparison of Conventional and Access Floor Designs

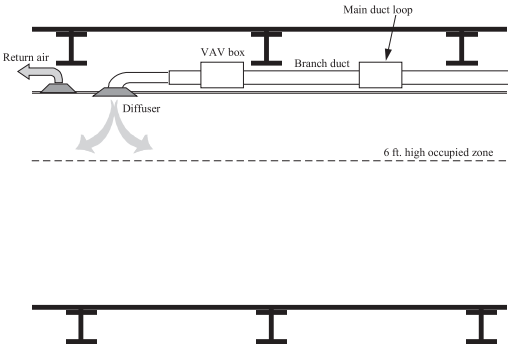


Conventional System Plan View

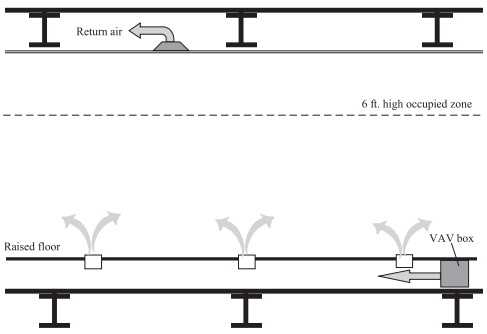


Access Floor System Plan View

The plan view shows the difference in ductwork necessary for access floor air distribution systems.



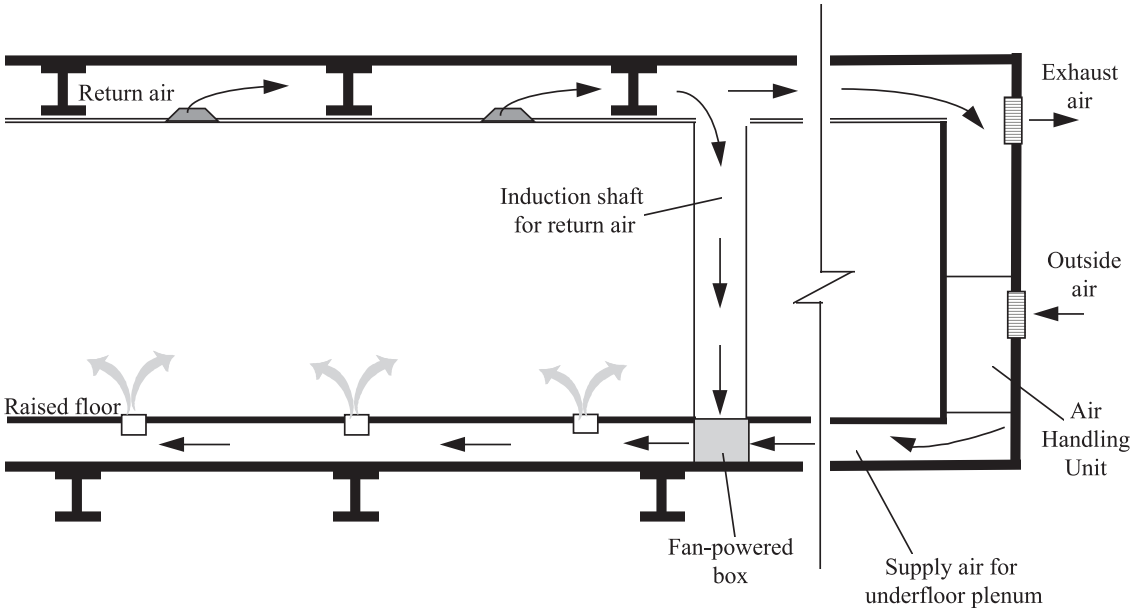
Conventional System Section View



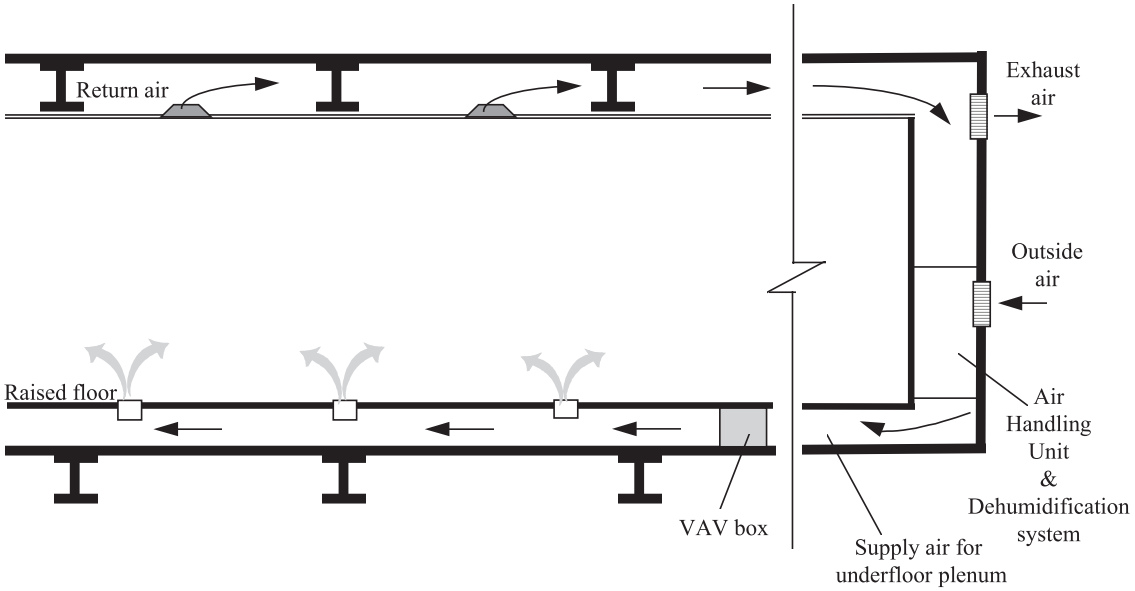
Access Floor System Section View

In the section view you can see that the floor-to-floor height does not increase to allow the use of access floor systems. The height of the occupied zone remains the same.

Proposed Layouts



In the above layout, some of the return air is mixed with the supply air through an induction shaft. This option uses 55ºF supply air mixed with warmer return air to create 65ºF air in the underfloor plenum.



In this layout, the return air is not mixed with the supply air. The outside air is dehumidified in a separate system before reaching the underfloor plenum.

Notes

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