# Underfloor Air Distribution (UFAD) Experiences based upon 10 million square feet of installations.

UFAD requires an extreme effort at integration to assure that the underfloor plenum can be pressurized. The plenum (with its extremely large surface area for leakage and penetration frequency is the integration of the following items:

- Concrete
- Masonry
- Gyp Drywall Systems
- Raised Access Floors
- Insulation
- Vapor Barriers
- Expansion Joints
- Sealants
- Joint Compounds
- Fire inhibitors
- Waterproofing
- Millwork
- Carpeting or other floor finishes
- Electrical Conduits
- Power Wiring
- Communication Cabling
- IT Networking
- Plumbing
- Ductwork
- And all the penetrations

Unfortunately, no single trade is responsible for these diverse items, making the integration all the more challenging.

Small amounts of water in the plenum (from very slow leaks or occupant spills) may support mold growth, and create IAQ problems. The supply air is introduced via this path, amplifying the exposure. Large leaks, or sprinkler discharge could lead to slab collapse. Fail safe water detection is a mandate, as is effective methods of water removal once detected.

Equipment in the plenum, such as VAV boxes, reheat coils and control valves, need to be readily accessible. However traditional open office layouts make removal of one or more work stations to gain access a necessity, followed by reinstallation of the work stations.

Air leakage of 40% to 210% of the design plenum supply air flow rates was measured during testing. Such extreme leakage makes thermal control difficult at best, and the energy waster monumental.

The key advertised attributes of UFAD ***that have not been realized include:***

- Improved thermal comfort
- Improved ventilation efficiency and IAQ
- Reduced Energy Use
- Reduced Life-cycle building costs
- Reduced floor to floor height in new construction
- Improved productivity and health

Thermal comfort often suffers since the manually operated floor diffusers have no active feedback controls. Users adjust to the idea that the temperature will often not be optimal due to changing thermal loads, much as was the case with the old steam radiators with manual valve control.

The concept that the air flow in the room is stratified, and hence exits the space at temperatures well above that needed in the lower occupied region, has not been observed. Consequently the theory that the supply air flow can be reduced is not true. And in fact, since the supply air must be at elevated temperatures when introduced at ankle level, almost twice as much air is required than with ceiling diffusers. What an energy penalty.

It has been noted from review of the Mechanical Schedules of actual construction documents that, contrary to conventional UFAD wisdom, the total static pressure of the fan systems are not much different than conventional systems. But in actual operation, the leakage rates have resulted in total static pressures being elevated above conventional systems.

Since the supply air is not stratified, but mixed, the ventilation effectiveness is not as good as expected. So the actual ventilation air flow requirements are higher than advertised.

Conclusion, UFAD provides no advantage compared to overhead air delivery (OAD) systems in terms of first cost, IEQ, operating costs, etc. And in fact they have been observed to be inferior to OAD systems in these areas. However it may still be better at accommodating office churn than OAD. Owners considering UFAD systems need to understand the reality of actual operational experience, and be willing to pay a premium to achieve mor3e flexibility during office churn.

SAM, Nov. 6, 2006

# Update on UFAD Experience: February, 2009

A building mechanical systems consulting engineer; with design, commissioning, and corrective action experience shares the following personal Under Floor Air Distribution (UFAD) system migration path from the late 1990s to today:

- The engineer believed the hype that it improved comfort, indoor air quality, energy efficiency, stratification and other design issues.
- The engineer gave UFAD seminars that went from being positive, to highly negative.
- Eventually the engineer stopped giving the seminars and now actually discourages the use of UFAD.
- The engineer's last UFAD job had so many problems that a vow was made to never design an UFAD system again unless the owner insisted, and that the floor plan was 100% open office.
- And even then, the engineer would probably duct most of it.
- The engineer's conclusion as of Feb. 2009: ***UFAD was a fad that has now gone by the wayside.***

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One might conclude, based upon the above and much other information, the following:

- UFAD systems mistakenly receive a positive LEED rating. It is mistaken since UFAD systems have been found/and continue to be weak in the areas of energy and environment,
- Perhaps regrettably, owners may still be slow to relinquish the UFAD systems favorable economics (i.e. GREENbacks) with respect to accommodating office churn.