TABB TALK
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Behind the UFAD TSUNAMI

UFAD's proponents certainly talk the talk, creating a tidal wave of interest. When it comes to facts—like actual performance of real-world installations—the 100-year-wave resembles a splash in the kiddie pool.

By A. Lee Chichester

Underfloor air distribution systems (UFAD) were being included in plans for numerous U.S. buildings still in the design stage. According to a tabulation performed near mid-year, UFAD was incorporated into buildings representing 20 million square feet of future construction.

With that increasing popularity, UFAD loomed large on the radar screen of the Emerging Markets Task Force of the National Energy Management Institute (NEMI—see www.nemionline.org).

As with any "hot" market, the Task Force moves in a closer look. What they found was somewhat alarming: A surprising lack of documentation for claims of versatility and advantages of UFADs over traditional systems.

So they looked harder.

Tsunami du jour

What the heck was the cause of this tsunami of interest in UFAD? This technology is neither "new" nor "cutting edge" by any definition; Thomas Jefferson designed and installed such a system more than 200 years ago at his showplace home, Monticello.

A call for help went out to sources familiar with HVAC systems performance measures, research, education, and testing. The Task Force looked within NEMI's resources, as well as those of the Testing, Adjusting, and Balancing Bureau (TABB) and The Building Diagnostics Research Institute, Inc.

Tsunamis start with earthquakes; what was behind the UFAD boom? Apparently, commercial real estate professionals and building owners looking for cost savings. "Expandable infrastructure" is the key.

Flexible, retrofit-ready workspaces are the bottom line. This siren song came from (among others), Alan Webber, Mike Vance, and Vivian Loftness.

Those speakers talked about "expandable infrastructure" at a 2002 meeting of the International Development Research Council (a global association of corporate real estate professionals). The speakers bring with them a fair amount of prestige: Webber once served as editorial director of the *Harvard Business Review*; Vance is the former dean of Walt Disney University; and Loftness chairs the Architecture Department at Carnegie Mellon University.

As savvy building owners seek to minimize the cost of tenant improvement work, UFAD is not alone. Owners are looking at many infrastructure variations, including those that make cubicle partitions/walls easier to move.

UFAD strengths—initial claims of lower installation costs plus energy savings—fed the tsunami! Recently, however, rumblings about UFAD's weaknesses—discovered in research and other places—have become loud enough to be found regularly on the Web (see accompanying story).

'I want to know'

Combined with the Task Force's exploration, the rumblings led to action. NEMI and TABB, working with the New York City and Long Island chapters of the Sheet Metal and Air-conditioning Contractors National Association (SMACNA) NYC and SMACNA Long Island, scheduled a New York-area seminar for engineers and architects.

Purpose: To bring forward some major UFAD concerns—and highlight ways they might be addressed in the design stage. Event invitations noted its purpose was to

"explore the expected performance of UFAD systems as alternatives to conventional air distribution (CAD) systems during design."

Can you counter a tsunami with facts? While only 50 invitations were mailed, attendance swelled to 135—including commercial building safety officials. Speakers at the spring 2004 event included Dr. James E. Woods of The Building Diagnostics Research Institute, Inc., and John Hamilton of TABB.

Most participants came to learn more— they were relatively few who obviously brought with them an "axe to grind." What drew such an overflow crowd? "There's a lot of talk in the industry about this system being at the forefront of design," said Damian Payne, EIT, a mechanical systems engineer for Loring Consulting Engineers of New York City.

"I wanted to know more."

First, seek solutions!

Simon Wu, P.E. with Arthur Metzler & Assoc. Consulting Engineers (New York City) felt about the same way as Payne—when the seminar began. "When I came, most of what I'd heard about UFADs was pretty positive," Wu noted.

"But now, hearing some of the challenges of the systems, I'm not so sure. It was a great seminar."

First, the seminar explored the very limited documentation of UFAD proponents' claims. There also isn't much research or data, attendees learned, from real-world UFAD installations—performance, testing, and cleaning issues.

"UFADs are simply one more tool in the kit," said Dr. Woods. "They aren't the silver bullet some would have us believe. The issues we've discussed here need to be addressed at the design stage, *not over* the life cycle of the building.

"Please, please—architects and engineers—work together at the beginning to incorporate solutions to these issues into the design of the systems."

Backwash On Purported Savings

In a February 2004 article posted to the ASHRAE Ottawa Valley Chapter Web site, Soheil Rastan, an indoor environments and healthy building technology specialist, posed many of the questions raised at the seminar.

Rastan is a consultant to Public Works and Government Services Canada. You can find his thoughts at www.ashrae.ottawa.on.ca—take the link to the "articles" section.

The title: "Some Thoughts on UFADs."

Before we present (with permission) one excerpt of special note, please first read Rastan's own caveat:

The issues raised in this commentary do not, in any way, reflect PWGSC's stand or opinion on UFADs. These are but personal opinions of an individual to be shared with ASHRAE's Ottawa Chapter colleagues and generate some sort of dialogue.

Rastan's report

"Plenum systems may be good leverage idea for return air. However, I have to think twice before acknowledging plenums as an effective system for supply air. This concern is for both indoor air quality as well as HVAC velocity-pressure control quality.

"Plenums (ceilings or floors), as we all know, are used not only for air but also for electrical and communication wirings, plumbing, auxiliary fans, evaporators, etc. The premise of return air passing by these exposed items and carrying whatever these wires and fans emit has been accepted (though reluctantly) by acknowledging the fact that such air will eventually pass through the filtration of the HVAC system (though with very limited removal efficiency) before it is delivered as a supply air.

"In such a case, the plenum air is at least being filtered after 'being-in-contact' with all the plenum-based gears. If we decide to go with a UFAD system, we may need to add filters on each floor supply diffuser. This entails that we recalculate pressure drops in the design of UFAD fan capacities.

"The latter may well eliminate some of the fan-based energy savings that are being claimed by UFAD advocates."

Questions & answers

A flavor of the event's atmosphere of vigorous inquiry was seen in the Q-and-A in the seminar room. While there's not enough space here for all of the questions and answers, here is a smattering—a feel:

'Bathtub effect'

Q—If a UFAD is installed in a building with a sprinkler system, and that system goes off, the water will collect in the under-floor plenum or cavity. Do we have to structurally design more weight load for the floors of multi-story buildings?

A—Not necessarily, but possibly. Prevention of the "bathtub effect" is the best strategy. So the design of the systems should include rapid drainage possibilities, water detection sensors, and level indicators.

It needs to be dealt with very quickly to avoid a pancaking building during a fire or other emergency.

Raised floor height?

Q—Is the design height of the raised floor a formula or an experiential measurement?

A—Height of the floor is dependent

Researching UFAD: What Washed Up

Dr. James Woods of the Building Diagnostics Research Institute, Inc. (www.buildingdiagnostics.org) conducted a literature search on UFAD in the fall of 2002. Here's what he found:

1. He was able to find only 65 buildings that clearly used UFAD systems. Of these:
   - 33% were in the West or Northwestern U.S. (meaning they had light latent loads);
   - 47% were in the Midwest and East (meaning large heat losses & large sensible heat loads in summer), and
   - 18% were located in the South (e.g., light sensible heat losses and large sensible and latent heat loads in summer).
2. The 65 buildings ranged in size from 2,000 sq. ft. to 3 million. The UFAD system installation generally did not extend to each building's entire floor space.
3. Only 30% were installed during new construction.
4. Occupant discomfort was reported for thermal, lack of air movement, drafts, noise, dust, and dirt. No illnesses or symptoms were reported; however, Dr. Woods noted that he has personally investigated such complaints in connection with UFAD.
5. Building occupants and managers reported UFAD systems were not in compliance with relative humidity and air movement criteria. Gas and particulate concentrations were more frequently in compliance
6. UFAD system problems included insufficient latent heat capacity, lack of controllability of temperature, pressurization, and compartmentalization
7. Energy and first-cost justifications were not validated

What's the meaning of this?

Here are Dr. Woods' interpretations:

- While they may present attractive alternatives, there are more limitations on UFAD application than proponents and marketing materials may suggest.
- There are many variations of UFADs. As it is not "one size fits all," investigators as well as proponents are precluded from providing simple characterization of advantages and disadvantages
- General claims of superior performance of UFADs are probably meaningless
- One would expect, based on the limited data, that UFAD non-compliance with evaluation criteria would be similar to that for conventional air distribution.
- Engineers and architects should await more specific design guidance on the use of UFADs. This should arrive via LEED 2.1 and GSA PBS-P100-2003.

upon the reason you're raising it—your flexibility requirement, and if you're putting electrical wiring, plumbing, and other equipment under there along with the air handling systems; or not.

Disappearing savings?

Q—After hearing all this, are the cost savings that are being touted really there at all?

A—This issue is how you design the system required by your application. I think you'll find, once you've taken into account all the solutions you've got to design into the systems to address these concerns, there will be very little cost difference between UFAD and CAD.

Risk & contamination

Q—It sounds as if there's a very scary concern regarding contamination issues with these systems.

A—You have to do a risk analysis of your space. Are you building in a high-risk area? If so, you might want to rethink the potentially more vulnerable UFAD system.

Goods news—and bad

The full day of discussions concluded with these comments.

From an invitee: "I see a big liability for engineers in designs of these systems. Who is going to be the authority having jurisdiction over the inherent problems we've discussed here? Is it worth it for cost savings, given that it appears the cost savings won't be that great?"

Dr. Woods: "Know everything you can about the tools at your disposal. Basically, document every step of the process. Assure that your owner understands all issues and warnings in all the choices you're making about a construction project. Document discussions and recommendations.

"Cover yourselves.

"UFADs are a good news/bad news type of thing. Both good and bad news is that the decision goes back to you engineers and architects. It's your individual choice given your knowledge of the systems, their application in each case, and the capacities of all the tools at your disposal—not just UFADs, but CADs as well." ■

Chichester, a Virginia-based freelancer, writes frequently on electrical and HVAC issues.