Dedicated OA Systems

Since ASHRAE Standard 62-1989 was published, engineers have speculated on reasons not to use dedicated OA (outdoor air) systems. The primary reason is the perception that added first cost and plenum depth would be required. However this reasoning may not be supported by fact.

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Using a dedicated outdoor air system is not a new idea. Gershon Meckler has designed systems and published articles on this subject for more than 20 years. Except for very unique situations with extremely restricted ceiling plenum spaces, the industry favors the all-air variable air volume (VAV) systems. Many designers have dismissed using a separate dedicated OA system because of cost and space limitations without careful analysis.

A dedicated outdoor air system is a 100% outdoor air constant volume system designed to deliver the volumetric flow rate of ventilation air to each conditioned space in the building. The ventilation air is introduced into the space via its own high aspiration diffusers, independent of any other mechanical system used to thermally condition the space. The system supplies the required minimum ventilation air to each space without regard for the complications of the multiple spaces approach (required by ASHRAE Standard 62) when the ventilation air is supplied via a single all-air system serving multiple spaces.

Why Dedicated OA Systems? Since ASHRAE Standard 62-1989 was published, engineers have speculated on reasons not to use dedicated OA systems. The primary reason is the perception that added first cost and plenum depth would be required. However this reasoning may not be supported by fact. The chief technical and economic incentive that led the author to first explore dedicated OA systems was the inability to verify, in real time, that the ventilation requirements had been met as discussed in the Mumma-Lee (ASHRAE 1998) paper. This lack of verification could easily lead to IAQ problems followed by costly litigation.

Four reasons to use dedicated outdoor air systems include:

1. Assurance (verifiable in a court of law) that every conditioned space will receive the required minimum ventilation air.
2. Generally, 20% to 30% less outdoor air must be conditioned (cooled and dehumidified in the summer; tempered and humidified in the winter) when the ventilation air is delivered with a dedicated system. This provides a significant energy savings.
3. The ventilation air can be used to provide 100% of the space latent load control (thus decoupling the space sensible and latent loads), with a very strong microbial growth inhibiting benefit.
4. The engineer has many approaches to meet the conditioned space sensible loads with a parallel system operating with dry surfaces. Approaches include all-air VAV systems, packaged unitary equipment, fan coil units, and ceiling radiant cooling panels. A dedicated outdoor air system with a parallel sensible cooling system is depicted in *Figure 1a* and a conventional system in *Figure 1b*.

Achieving dry OA efficiently and economically. Good energy performance may be achieved using a system consisting of an enthalpy wheel to precondition the OA with building relief air (cooling and dehumidifying the OA in the summer and heating and humidifying the OA in the winter), which is followed by a dehumidification cooling coil to dehumidify the ventilation air sufficiently so it can remove all of the space latent loads. If a supply air temperature greater than the required supply air dew point temperature is desired, the cooling coil is followed by a sensible heat exchanger to reheat the supply air with energy recovered from the relief air stream. Such a system, a dual-wheel system also labeled a DOAS, is depicted in *Figure 2*.

Integrated dedicated outdoor air concept. Space in this column does not permit support for the comments that follow, however that support is presented in the papers published in *ASHRAE Transactions* 107, Part 1, 2001.

1. Employ a dedicated OA system designed to deliver the minimum ventilation air to each conditioned space.
2. Condition that air with a dual wheel system for a energy-efficient approach.
3. The supply air leaving the dedicated outdoor air dual wheel system needs to have a dew-point temperature around 45°F (7°C) to remove all of the space latent load and maintain a satisfactory space DPT, and a dry-bulb temperature no higher than 55°F (13°C) (typical for all-air VAV system).
4. Diffuse the ventilation air (only about 15% to 20% as much air as circulated with an all-air VAV system) into the space with high aspiration diffusers to provide acceptable ADPI, minimize cold jets, and eliminate stagnant regions.
5. Select ceiling radiant cooling panels as the parallel system to absorb the sensible load not met with the 55°F (13°C) or lower ventilation air. The panels are able to absorb roughly 30 Btu/hr·ft^2; use very little plenum space; are modular and easily reconfigured with ever-changing building use patterns; can be installed for a lower first cost than the VAV boxes in a conventional all-air VAV system; use very little thermal transport energy (when compared to

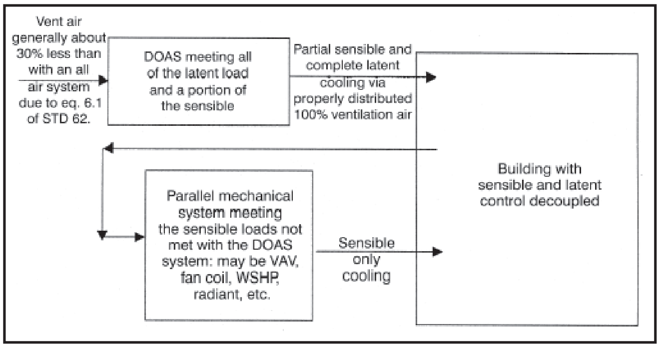

Figure 1a: DOAS/Parallel arrangement with decoupled latent control, the new paradigm.

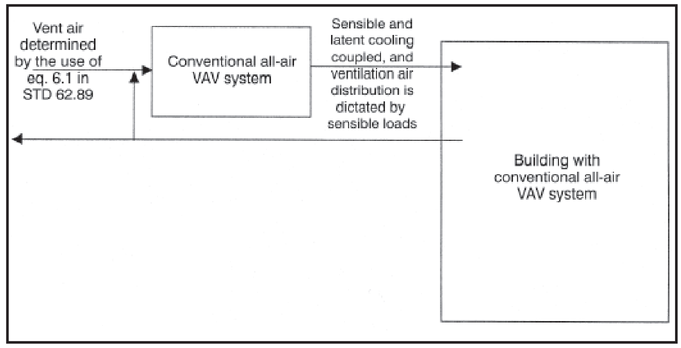

Figure 1b: Basic arrangement of an all-air VAV system, the current paradigm.

any air system; and generally require only about half of the ceiling area.

The European community has been using the ceiling panel concept very successfully for more than 15 years, and has a mature manufacturing infrastructure in place. Only one hydronic radiant ceiling panel manufacturer exists in the United States at this time. Its product is designed for heating and is extremely over-designed for the low flux conditions of cooling applications. Many opportunities exist for U.S. manufacturers to enter the potential $5 billion/year to $50 billion/year business.

6. The noninsulated fire suppression transport system can be used to distribute the cool water (about 55°F [13°C], or several degrees warmer than the space DPT of 52°F [11°C]) to the panels, greatly reducing the first cost of providing a separate thermal transport system. This has been recognized as a viable option in the NFPA 13 code.

Conclusions

The author believes that the engineering design community is on the verge of a major paradigm shift concerning the delivery of ventilation air.

To briefly recap the pillars of this new paradigm, they are:

1. *The real intent of ASHRAE Standard 62 cannot be met with an all-air VAV system (that leaves those who design this way wide open to litigation)*. Therefore, a separate dedicated OA system must be used to supply conditioned air directly into each space of the building (it can not be mixed in with an all-air VAV system).
2. *Condition the OA to a dew point low enough (around 45°F [9°C]) to accommodate 100% of the space latent loads*. This can be accomplished very energy efficiently with a dual-wheel heat-recovery system in conjunction with a chilled water coil. This de-coupling of the latent and sensible space loads essentially eliminates microbial problems throughout the building and paves the way for the third pillar.
3. *The remaining sensible space loads can be accommodated with a parallel system,* preferably fan coil units, or ceiling radiant cooling panels (operating with dry surfaces!). Energy transport, via cool water (55°F [13°C]), can be accomplished by the functional integration of the noninsulated fire suppression system (clearly approved in NFPA 13) at a marked reduction in first cost.

The improved IAQ, and thermal comfort that results from de-coupling the sensible and latent loads cannot be underestimated. Further, the first and energy costs of the new paradigm when using radiant cooling are significant. Finally, savings in ceiling plenum depth, with ductwork for only about 20% of the normal all-air VAV system and flat radiant panels could easily be several feet or more per floor.

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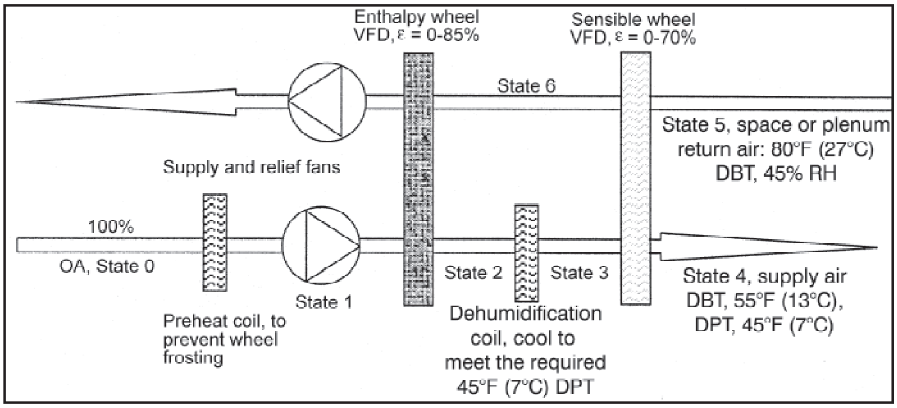

Figure 2: General Arrangement Of The Dual-Wheel System.

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Kids With Asthma May Be Reacting to Mouse Allergen

BALTIMORE—Mouse allergen, in the form of mouse urine or dander, is widely distributed in the inner city and may be a significant contributing factor to the childhood asthma epidemic in urban areas, according to two studies by Johns Hopkins researchers published in the December issue of the *Journal of Allergy and Clinical Immunology*.

"Before these studies, mice weren't widely recognized as an allergen in homes," says Robert Wood, M.D., associate professor of pediatrics at Hopkins and lead investigator of both studies. "Now we know that houses are full of it, and we were surprised that mice turned out to be even more important in inner-city asthma than cats, dogs or dust mites."

In a study of eight cities, scientists discovered that 95% of all homes studied had mouse allergen in at least one room; Baltimore topped the charts with 100%.

Eighteen percent of the children were allergic to mice and they tended to have more severe asthma.

Finally, they found that the more a person was exposed to mice, the greater the chances that future rendezvous with these rodents would cause a reaction.

For several years, researchers have known that cats, dogs, dust mites and cockroaches can cause allergies that trigger the wheezing and constricted airways of asthma. But while doctors have treated people who work with mice in laboratories for allergies to the furry creatures, until now not much was known about mouse allergy in the general population.

To fill this gap, Wood and his colleagues turned to data from the National Cooperative Inner-City Asthma Study, a multicenter study of 1,528 children.

The researchers analyzed dust samples from the homes of 608 children. Ninety-five percent of these homes had detectable mouse allergen in at least one room, with the highest levels found in the kitchen, followed by the bedroom and television/living room. Eighty-seven percent of the samples from each room in the study had detectable mouse urine or dander.

Of the 608 children, 499 had undergone puncture skin tests for all sorts of allergy, including cockroaches, mice, grasses and cats, and came from homes with adequate dust samples. The remainder of homes did not have large enough samples because of superior cleaning skills or difficulty getting dust from non-carpeted floors, or because dust had been used up during other tests.

"We found that 18% of these children had mouse allergy, and there was a connection between the allergy and asthma severity," says Wood.