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Research Validates VAV

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A recently completed ASHRAE research project (RP-1515) has yielded a number of interesting results. Performed in various locations of Northern California, the study collected information such as occupant satisfaction, equipment operation, and energy use. The study modified the settings of VAV terminals in response to observations, which proved successful in both increasing occupant satisfaction and reducing energy consumption.

The base design was a single-duct VAV terminal with hot water reheat and DDC. Typical for most large buildings, the interior was designed at 1 cfm/ft^2 (0.5 L/s · m^2) with the perimeter at higher rates, depending on orientation. Minimums were originally set at 30% of maximum. Plaque-type diffusers were installed to deliver air to the space.

One of the parameters monitored was natural gas use, which was only used for the boilers. Surprisingly, they found the boiler was being used year-round by the system, as the interior zones were going into reheat every afternoon. At the same time, occupants complained it was too cool in many interior locations. Apparently, the 0.3 cfm/ft^2 (0.1 L/s · m^2) minimum airflow rate was supplying more cooling than was needed and combined with the deadband in the controller, it resulted in spaces being a couple degrees below setpoint. They reset the minimums to a lower value (0.1 cfm/ft^2 [0.05 L/s · m^2]) and found that the actual interior load required only slightly more than 0.2 cfm/ft^2 (0.09 L/s · m^2) in most spaces. The adjustment increased occupant satisfaction considerably.

At the low airflows, there were no complaints of lack of air motion, which has always been a concern with VAV systems. Given the location and low airflows, the California code ventilation requirement resulted in 100% outside air. The only occupant complaints with this system seemed to be at design flow early in the day, as the space was being brought to design conditions. This was apparently from jet collisions at the midpoint between diffusers (further data analysis is under way to confirm this). Similar observations were made at the other sites in the study by which we can conclude the following.

- VAV systems at very low flows can provide acceptable environments, if the temperature is controlled.
- Designing for 1 cfm/ft^2 (0.5 L/s · m^2) is likely far too much air; minimums need to be set below 0.3 cfm/ft^2 (0.1 L/s · m^2).
- The ventilation load is the most important load in the interior zone.
- VAV minimums set too high will subcool the space, causing occupants to complain, or worse, run space heaters. VAV terminals may go into reheat.

There were a number of other observations and conclusions from the study, which will undoubtedly be presented in future articles. ■

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