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PRODUCT: Terminal Units – Fan Powered Terminal Units
SUBJECT: Efficiency Of Fan Powered Air Terminal Units – PART II
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All the improvements listed in part 1 have combined to allow us to control ventilation, humidity and comfort levels in the occupied space better than ever before. What makes it more efficient is that we have developed components that are more efficient at part loads. For office buildings in the cooling mode, the space demand is generally at or below 50% of the design point 80% of the time. In the heating mode, the demand levels are generally at or below 35% of the design point 95% of the time. Series fan powered ATUs are the primary components of the system that make these part load operating levels efficient by reducing system static pressure, motor heat, plenum heat and air volume requirements.

ASHRAE RP 1292 investigated the differences between series and parallel units. The goals were use what we found to discover how to build better buildings, how to create better internal environments and how to capitalize on new and existing technologies. The technologies included dedicated outdoor air systems and lower coil and discharge air temperatures. Investigating what ECMs could add was reserved for another research project. I described the findings of the research in an ASHRAE paper, Reflections on ARI/ASHRAE Research Project 1292, Comparison of the Total Energy Consumption of Series Versus Parallel Fan Powered Terminal Units. The paper is available from ASHRAE as are all the research papers mentioned in part 1. Strictly from a building energy point of view, the parallel and series ATUs were equal. Buildings used about the same amount of energy no matter which unit was used, but the energy use was very different. Buildings with series units consumed energy with a constantly running low efficiency PSC motors and the amount of warm plenum air that was pulled into the units during part load conditions. Buildings with parallel units consumed energy due to higher static pressures required at the air handlers in the duct system and leakage at the ATU. The amount of leakage has been debated and may still be debated somewhat. It is safe to say that the samples supplied to the research group were as perfect as the manufacturers could make them. Leakage was not only the largest single energy user, but it gets worse with age.

The VAV Consortium investigated what happens when ECMs replace PSCs in both the parallel and the series units. The findings were dramatic. The parallel unit had no real improvement in energy consumption because the motor only runs in the deadband and heating modes. In those modes, the 2° to 5°F. temperature rise across the motor was used for heating the space. ECMs eliminated that, and additional heat had to be applied to keep the space under control. The series unit fared much

better. The energy use in the motor decreased 67% at design point. Additionally, modulating the fan for part load conditions not only reduced the motor energy, but it also decreased the amount of warm ceiling air being mixed with the cooling air in the ATU. Energy levels at the chillers, air handlers, towers and terminal units all decreased. Several papers were written on this subject, and some continue to be written today.

Chapter 8 in the ASHRAE DESIGN GUIDE for Air Terminal Units covers some building energy modeling comparing the same building using single duct ATUs, parallel ATUs and series ATUs. Both fan powered ATUs outperformed the single duct models. Using a worst case interior space condition, the modeling shows that series units can save as much as 3 to 5% of the entire electrical load on the building when compared to parallel units. Earlier modeling using alternate interior space conditions showed greater savings.

Additional research, ASHRAE RP 1515, shows that real loads in the occupied space are much lower than those presently being designed for. Using this research along with proper CO2 controls and series fan powered ATUs can significantly reduce equipment energy beyond those levels mentioned above while maintaining reasonable comfort, humidity and ventilation levels in the occupied spaces. A new version of the series unit, the Fan Powered Chilled Water Terminal Unit, offers some new approaches and opportunities. This is basically a series unit with a chilled water coil over the induction port. Control sequences to control the preconditioned very dry outdoor air, the water temperature and flow through the coil, the heating device and the fan airflow to the space are critical. But when done correctly, this device can control the humidity, temperature and ventilation to the space without the use of air handlers in the building other than for outdoor air preconditioning.

Series fan powered ATUs have gone through several metamorphoses since their inception in the late 1970s. Today, if used with the proper controls and applied properly, they offer a highly efficient and comfortable method for conditioning modern office buildings. They are here to stay.