

Recommendations for Low Energy VAV Systems

This document is a portion of the White Paper titled
“Comparing Energy Savings of Different VAV Systems”
prepared by Martyn Dodd of EnergySoft, LLC.

Select the lowest horsepower fan and control it for low turndown horsepower.

- Maximum fan power should not exceed 0.72 W/cfm.
- Use a more efficient scroll type airfoil centrifugal fan when noise and space limits allow.
- Use a variable speed drive (VSD) on the fan.
- Control the VSD from a static pressure sensor located close to the last VAV terminal in the duct run. Use multiple sensors for duct work with multiple branches.
- Use the lowest pressure drop air system possible. (See “Design for the lowest possible pressure drop in the VAV system” below.)
- Specify that no balancing damper shall be installed before the last VAV terminal or the last diffuser (alternatively that the balancing damper before the last VAV terminal or last diffuser shall remain open) so that the system will be balanced at the lowest possible fan speed.

Eliminate or reduce the need for reheat.

- Eliminate the need for reheat by adding enough inexpensive insulation to the building envelope until the heat loss through the envelope at outside temperature below winter design is less than the heat gain of the occupants and other internal loads in perimeter spaces. Warm-up heating may still be required.
- Eliminate the need for reheat by using separate air handling units for each heating zone such as one per exposure and one for the interior.
- Use high induction diffusers to reduce stratification. (All VAV diffusers are high induction.)
- Use the lowest possible minimum flow set point. Must be the higher of the minimum ventilation requirement or the lowest allowed by the terminal (10% of design air flow for VAV diffusers, higher for most VAV boxes).
- Use a slightly higher supply air temperature. An increase in the supply air temperature will require a larger volume of air. Use the model to find the ideal compromise between reheat energy and fan energy.
- Increasing the use of fan energy to lower use of central plant energy can seldom be justified except when also reducing reheat. One method is to reset supply air temperature during cool weather and size interior zones for 60°F or higher supply air. Supply air reset may not be beneficial in warm climates and in high humidity locations where alternate dehumidification may be required.

Provide the smallest possible zones.

- Try to provide a VAV zone and a thermostat for each occupant.

Design for the lowest possible pressure drop in the VAV system.

Fan

- Minimize the fan outlet effect with a straight run duct or an elbow in the direction of the fan rotation.
- Use duct liner only where necessary for sound attenuation. Use the minimum needed. Avoid sound traps.

Coils

- Select the largest coil that can fit in the space - maximum face velocity of 450 fpm and minimum water side ΔT of 15°F.

Filters

- Avoid pre-filters.
- Use the largest filter bank that can fit in the space.
- Select low pressure drop extended surface area filters.

Risers

- Place the shafts close to the air handler but, for sound attenuation, not directly under it (except connect ducts to rooftop units through insulated roof curb to avoid ducts outside the building envelope).
- Size for 800 to 1200 fpm at the floor closest to the air handler.
- Consider multiple air shafts for large floor plans.

Supply air ducting

- Make as straight as possible with a minimum of transitions and joints.
- Use large radius elbows and low pressure drop fittings and takeoffs.
- Size for a pressure drop no greater than 0.08"wg per 100 ft and a maximum of 1200 fpm.
- Limit use of flex ducting to a maximum of 5ft at the diffusers.
- Use duct liner only where necessary for sound attenuation. Avoid sound traps.

VAV terminals

- Use VAV diffusers instead of VAV boxes – a lower pressure drop by 0.25"wg to 0.75"wg usually reduces fan HP by 30 to 50%
- Size terminals for low static pressure drops – between 0.25"wg and 0.05"wg for VAV diffusers and 1"wg to 0.5"wg for VAV boxes

Return air

- Provide at least one return air grill for each VAV zone, more if the zone is large.
- Use ceiling return air plenums (except in high humidity locations such as DOE climate zone 1.). Seal ceiling plenums for minimum air infiltration.
- Size ducts for pressure drop no greater than 0.04"wg per 100 ft.
- Size grills for pressure drop no greater than 0.08"wg.

Provide separate auxiliary cooling systems to serve 24/7 process loads such as server rooms and telecom closets and other loads that do not operate on the normal HVAC schedule.