

To find the most efficient way of Air Conditioning a building using a Fan Coil System

Room air temperature is measured by either a room thermostat or return air sensor wired to the fan coil controller. The actual temperature is compared with the set point temperature and the relevant controller output operated. The controller output operates the fan air volume and modulating valves which govern the flow of water through the heating or cooling coils.

How VAV Waterside Fan Coils Operate

Isothermal Mode: This is where the room temperature is at the design value (set point) and no heating or cooling is required. In this mode the water control valves, hot and cold, will be closed BUT the fan will be running typically at 60% volume.

Cooling Mode: As the room air temperature increases a signal from the sensor to the controller starts to open the chilled water control valve. Care must be taken with the coil air-off temperature such that the air entering the room is not too low and cause potential air distribution issues. It may be prudent to introduce a temperature sensor to monitor the coil air-off and at the specified minimum temperature, start to increase the air volume. If the room air temperature continues to increase, the controller opens the chilled water valve further and then increases the motor speed.

Heating Mode: As the room air temperature decreases a signal from the sensor to the controller starts to open the hot water control valve. If the room air temperature continues to fall, the controller opens the hot water valve further and then increases the motor speed.

All of this is captured in the control diagram Figure 1 which also shows a 2°C dead band where the fan coil operates in the isothermal mode.

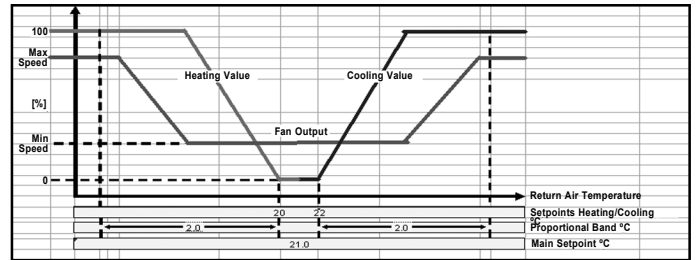
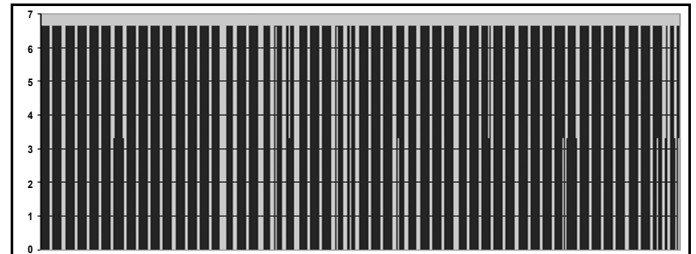
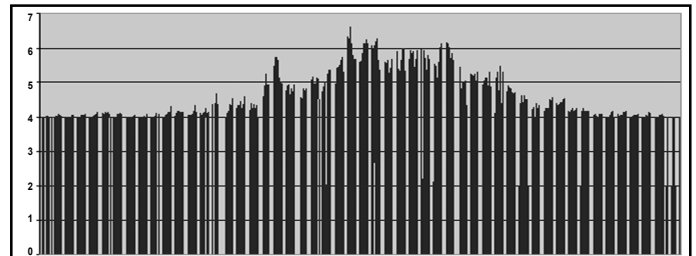


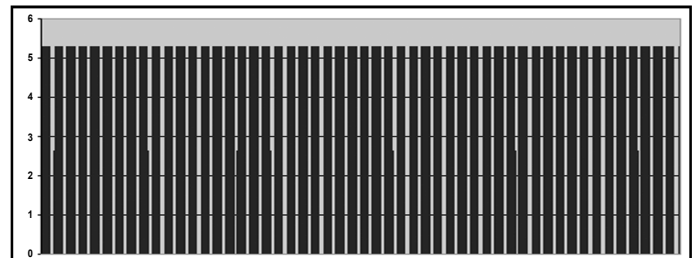
Figure 1 - VAV FCU Control Sequence



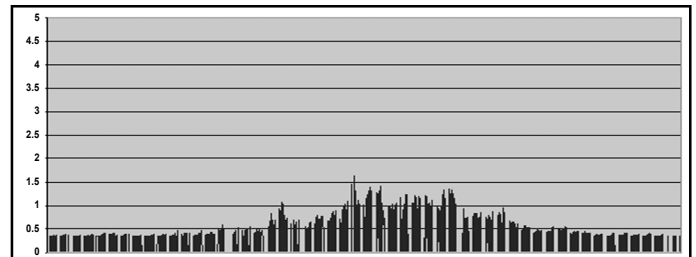
CAV Airflow (l/s / m²) v Hourly Input over 12 Months



VAV Airflow (l/s / m²) v Hourly Input over 12 Months



CAV - Fan Energy (kW) v Hourly Input over 12 Months



VAV - Fan Energy (kW) v Hourly Input over 12 Months

Element	TER 2006	BER AC/FCU	BER VAV/FCU
Lighting	17.5	12	12
Motor Power	8.2	10	3.5
Cooling	9	6	6
Heating & Hot Water	2	2	2
Total	36.7	30	23.5

Saving in Total Carbon Emissions for VAV compared with CAV Fan Coils = 22.7%

VAV FCU – The System Approach

Using VAV FCU the importance of air distribution must be emphasised to ensure comfort conditions are met at all times. At minimum air volumes adequate air movement is maintained and the diffuser coanda effect is sustained. At maximum air volumes, the diffuser does not overthrow, create excessive noise or external static resistance. This re-enforces the complete system approach.

This reduces energy consumption and emissions. On top of this, by varying the motor's speed to suit the heating or cooling requirement, the motor running cost is reduced and energy is saved.

The total building services system carbon emissions have been evaluated using real fan coil test data with a bespoke software package such as TAS.

A simple building model has been used to provide basic space heating and cooling demand hourly for a typical London weather set (TRY). The model is to Part L2 standards.

The open plan first floor of the model (30m by 30m) forms the basis of the analysis. It has been subdivided into perimeter and core zones according to the NCM.

Thermostat controls have been set at 18°C heating and 24°C cooling with 2°C proportional control ranges and a 2°C dead band (as per figure 1).

A basic set of internal heat gains has been used for all zones.

The simulation of the building provides hourly profiles of heating and cooling demand.

A comparison of a CAV Fan Coil, which includes SFP of 0.8, 10 ACH of room air, 0% fan turndown and design margin; against a VAV Fan Coil, which includes SFP, fan of 0.25, 10 ACH room air, 60% fan turndown and design margin.

The annual fan energy use for the CAV fan coil with AC motor 13,800kWh.

The annual fan energy use for the VAV fan coil with EC motor 1,405kWh.

If we consider the improvements which have been made in the design and construction of buildings we can see that there has been significant reductions in carbon emissions.