Alan Basnett is head of sales at Advanced Air

EC motors leading the charge

Alan Basnett discusses the changes that have taken place in the terminal air conditioning market and how these have been driven by the quest for reductions in carbon emissions from fan coil units

Market statistics reported by BSRIA show there has been a dramatic change in the terminal air conditioning market. From 2000 to 2008 chilled beams increased in popularity due mainly to their superior carbon credentials and in some years the increase in market size was as high as 40 per cent. Current statistics show that fan coils have made up lost ground. The market for this system is now nearly three times the size of chilled beams. Most of this change is due to the motor technology that has advanced tremendously driven by the need to reduce energy consumption.

In terms of benefits to the building services industry most noticeably we have seen the development of small DC (direct current) motors, and more latterly the development of so-called "smart" electronically commutated motors – ECM. Horizontally mounted fans shown in Fig. 1 give a highly efficient fan deck arrangement.

DC motors are intrinsically more efficient than their equivalent AC (alternating current) counterparts - DC motors are synchronous devices – there is no rotor slip. ECM motors offer even greater efficiencies due to their internally programmable functions.

External static pressure

The performance of fan coil units is usually stated at an external static pressure of 30 Pa., in reality the fan coil unit may never operate at that condition – there can be excessive flexible ductwork, tortuous ductwork connections onto diffuser/plenums, and of course air inlet filters become congested over a period of time. In fan coil units with conventional motors, these additional resistances will result in the performance being de-rated and the motor(s) operating less efficiently – the fan goes back on its operating curve and the motor generates more heat. ECM motors are electronically commutated – there are no brushes – consequently there is no motor heat generation which needs to be allowed for in the overall cooling requirement calculation.

ECM motors can be programmed to operate at constant pressure or constant speed. In the case of fan coil units we would most often elect for constant air volume to ensure that the cooling/heating duty(ies) are continuously met. The ECM motor has integrated software which analyses various operating parameters - speed, torque and power. Once the motor/fan assembly has been characterised to the software, the inputted air volume set-point corresponds to a given speed/torque value. If the external static pressure increases – as in instances of extended ductwork or air filter congestion, then the change in internal parameters is sensed and the fan speed is automatically reset to maintain constant discharge air volume. We should not consider the motor/fan assembly performance simply as a curve, but more as a rectangle providing an almost infinite range of air volume /external static pressure settings.

ECM motors applied to fan coil units can be interfaced with building management systems via digital controllers incorporating 0-10 Vdc. (4-20mA) control signal. This enables the discharge air volume to be reset remotely at any point in the linear voltage range to match actual site requirements.

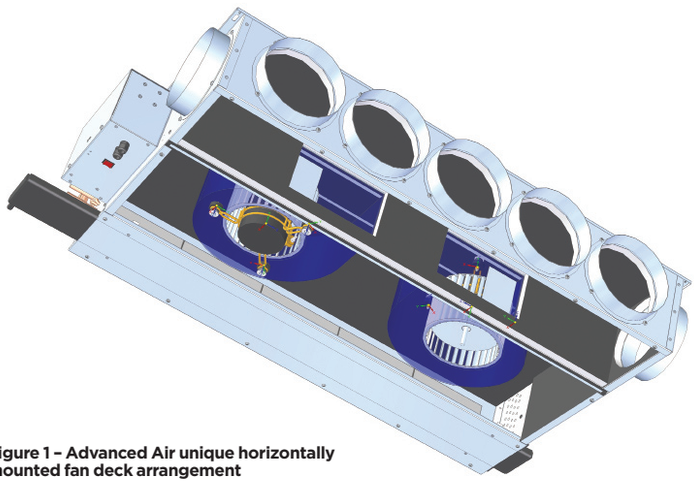

Figure 1 – Advanced Air unique horizontally mounted fan deck arrangement

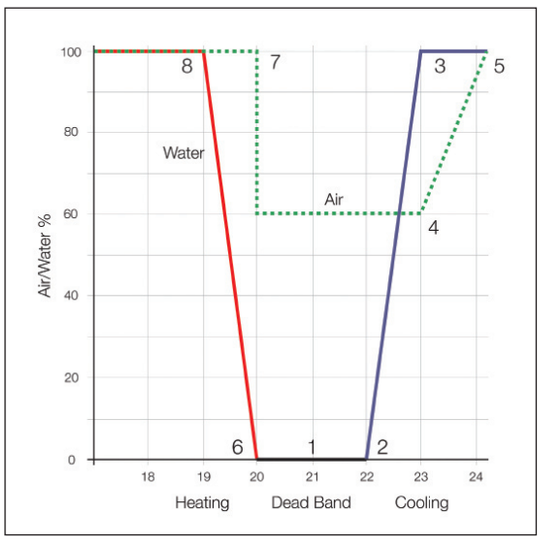

Figure 2 – VAV Control Strategy

> **"Statistics show that fan oils have made up lost ground. The market for this system is now nearly three times the size of chilled beams"**

Uncorrected fan power

Another important issue with the ECM fan deck developed by my company is that the uncorrected fan power to the ECM is current leading. This is in opposition to the typical building power which generally is inductive in nature with the current lagging power. The ECM is capacitive when the power is uncorrected. This means that an inductive building would benefit from ECMs since they would cancel out the motor capacitance and act as an automatic power factor correction device. This remarkable feature has come to light via Nailor Industries (parent company to Advanced Air) with over two million square feet of offices in the USA that have gained from this feature.

ECM fan decks mean that variable speed and hence variable air volume is easy to achieve. In the past it has been common practise to run the fans at 100 per cent air volume irrespective of the heating and cooling requirement. Now we have the opportunity of varying the volume between 100% and 60% according to the loads in the building resulting in further significant savings in energy. To achieve the VAV the control strategy is shown in Fig. 2. With VAV operation specific fan powers of around 0.15 Watts per litre per second can be achieved compared to 0.6 in the current building regulations. So the EC motor technology has transformed the popularity of the fan coil systems so much so that it's now chosen for most projects.

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