Ventilation on demand

Delivering too much ventilation air to a building is wasteful of energy and increases the cost of running that building. **Marcus Lightfoot**, chairman of HEVAC's Demand Controlled Ventilation Group, looks at the effectiveness of demand-controlled ventilation.

As buildings become more airtight and well insulated, purpose-provided ventilation is required to create a safe, healthy and comfortable indoor climate and protect the building against damage that may be caused by moisture.

Enough is enough

The minimum required ventilation rate is often based on maximum occupancy. However, dwellings are not always fully or continually occupied. If we can control the ventilation rate based on actual occupancy and activity, we have the potential to reduce the ventilation rate and, therefore, reduce the annual energy required to power the fan(s) and save energy without compromising indoor air quality.

Additionally, if demand-controlled ventilation enables home owners or tenants to ventilate less during the heating season and more during hot summer nights, the annual energy requirement to heat or cool the outdoor air also decreases.

The Demand Controlled Ventilation (DCV) Group has been set up to gain recognition for control as a sustainable ventilation strategy for new and existing buildings.

Sensor technology

Demand-controlled ventilation (DCV) systems employ sensors to detect the level of occupancy and activity by measuring water vapour, CO2 or other pollutants and adjust the ventilation rate accordingly (both dynamically and automatically) to avoid excessive ventilation and reduce the energy consumption of systems that run continuously at fixed ventilation rates.

It is important to appreciate that although water vapour and CO2 levels correlate well with human occupancy and human-generated pollutants, they do not reflect the build-up of pollutants not related to occupancy. DCV therefore needs to ensure that all potential contaminants remain at the specified safe levels when the building is occupied.

More is sometimes better

It is widely believed that actual occupancy levels in private housing are lower than those that conventional ventilation systems are designed to handle. It is also believed that the actual occupancy levels in social housing is higher than those that conventional ventilation systems are designed to handle. In both cases, DCV offers a strategy to optimise the balance between the necessity of creating and sustaining a healthy and comfortable indoor climate and using as little energy as possible in the process.

It's science, but not rocket science. The equation for heat required to heat incoming air from ambient temperature to indoor temperature from EN 15241 ('Ventilation for buildings. Calculation methods for energy losses due to ventilation and infiltration in buildings') is:

$$P_{heat} = \rho \times c \times q_V \times \Delta T$$

ρ is the density of air, c is its specific heat, q_V is the flow rate of fresh air and ΔT is the temperature difference between indoors and outdoors. You will need to keep the units consistent.

The formula above clearly shows how energy can be saved with ventilation systems.

One approach is to reduce the uncontrolled flow of fresh air into the building (infiltration). Although DCV systems can and do use infiltration air, (theoretical) infiltration rate calculations should not be used for ventilation system design.

Energy savings can also be achieved by reducing the controlled flow of fresh air into the building (ventilation) to the minimum level required without making any concessions to indoor air quality in three ways.

- Controlling the volume of fresh air flowing into the building according to occupancy and activity (DCV).
- Improving ventilation effectiveness/efficiency.
- Reducing the generation/emission of pollutants as much as possible (e.g. VOCs, formaldehyde, radon etc.) to reduce the minimum ventilation rate when the building or a room is unoccupied.

Energy can also be saved by reducing the temperature difference between the outdoor air temperature and desired indoor air temperature using mechanical ventilation with heat recovery (MVHR).

Another energy-saving measure is to minimise air leakage and pressure loss in air-distribution systems and maintain them periodically.

Use fans which have a low SFP (specific fan power) in the operating area that they are used the most.

Finally, choose suitable filters and maintain them regularly.

To see two DCV systems at work visit the web site of the Demand Controlled Ventilation Group (www.feta.co.uk/dcv/dcv-01.htm).

Marcus Lightfoot is chairman of the HEVAC Demand Controlled Ventilation Group and managing director of Ubbink (UK).

Energy-efficient ventilation — Marcus Lightfoot.

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Readers will surely be familiar with this image used by Aereco, a member of FETA's Demand Controlled Ventilation Group, to illustrate the concept of increasingly airtight buildings.