COMFORTABLE BUILDINGS – THE WAY AHEAD

A new Voltimum expert panel is helping to save energy by supporting the adoption of modern heating and ventilation systems.

By James Hunt

THE TREND towards airtight building design is resulting in indoor environments characterised by a complex mix of gaseous and particulate contaminants that can be harmful for building occupants and home owners.

The contaminants can arise from water vapour, emissions from cleaning products, construction activities, carpets and other furnishings, perfumes, cigarette smoke, electronic machines, microbial growth (fungal/mould and bacterial), as well as insects and external pollutants. Indoor temperatures, relative humidity and ventilation levels can also make life uncomfortable for buildings and their occupants.

As a consequence, indoor air quality (IAQ) – combined with energy saving and emissions reducing activities – has become an increasingly important health-and-safety topic. Four basic factors can lead to IAQ problems:

- **poor indoor environment – too low a temperature, excessive humidity and noise, plus certain lighting issues;**
- **indoor air contaminants – as already described**
- **insufficient outdoor air intake;**
- **outdoor environment – e.g. radon gas.**

To counter these factors, and to improve the comfort, wellbeing and health of building occupants, ventilation is used to replace the air in any building space to provide high indoor air quality. The link between good ventilation and productivity is well established within the work environment. Good ventilation can also save money by reducing building maintenance requirements by lessening damp and inhibiting mould growth.

Ventilation achieves these benefits by controlling indoor temperatures and replenishing oxygen, while removing unpleasant smells, smoke, dusts, airborne bacteria and carbon dioxide (CO_2). Interior building air is kept circulating (in the spaces where ventilation is fitted), helping to reduce air stagnation.

Heating, whether using standalone heaters or central heating, is also used to make life more comfortable for building occupants in cold weather. It can also improve productivity at work.

A central-heating system provides warmth to part of or the whole interior of a building, from one point to a number of rooms. Combined with other systems to control the building climate, the whole may become a heating, ventilating and air-conditioning (HVAC) system.

Both heating and cooling systems use energy, and there is a major drive towards making such

Modern building HVAC systems can make for more comfortable homes, and save energy

systems as energy efficient as possible, as required by regulations, such as Parts L and F of the Building Regulations. The result has been the rapid development of far more energy-efficient heating and ventilating products and systems using new technologies and clever control strategies. Alternative systems, such as heat pumps, also have their part to play.

A new HVAC Expert Panel

Reflecting the growing importance of HVAC, Voltimum UK and its partners involved in these two related sectors have recently formed the 'Electrical Heating, Ventilation & Control Expert Panel'. Its members will meet regularly, with the aim of bringing industry-specific issues and opportunities to both manufacturers and Voltimum UK users.

The panel's aims include furthering adoption of the latest, most energy-efficient systems, and it will issue technical white papers about heating and ventilating systems and related equipment. It will also provide webinars and seminars, and will answer queries.

The Voltimum UK Partner companies currently involved are: BEAMA, Redring–Xpelair, Glen Dimplex, Horstmann, and Vent-Axia, with other leading manufacturers and organisations soon to join. BEAMA's marketing director Kelly Butler chairs the new panel.

A wide range of heating and ventilating topics are of interest to the panel, including:

- **Building Regulations Part G – sanitary hot water and water heating guidance;**
- **energy labelling for water heating;**
- **the ErP Directive' (Energy-related Products) regarding fans and heaters;**
- **Standard Assessment Procedures (SAPs).**

The DuoHeat radiator by Dimplex features a heat manager that automatically controls the output from each heat source, optimising controllability and economy

Ventilation types

Ventilation systems can be categorised under two basic headings: natural ventilation and mechanical, or forced, ventilation.

As the name implies, natural ventilation uses the external air to ventilate a room or building without using a fan or other mechanical system. It can be achieved using opening windows and/or trickle vents (smaller systems), and in larger, more complex buildings, the 'stack effect' can be used, where cool outside air is drawn into the building naturally through low-level openings. It then rises, ventilates, and passes out of upper vents to the outside again.

In the case of mechanical ventilation, a room or a building's internal air is passed through an air handling unit (AHU) which conditions and circulates air as part of a heating, ventilating, and air-conditioning (HVAC) system. Alternatively, it can be passed directly into the space by a motor-driven fan; a strategically-placed exhaust fan can improve air infiltration or natural ventilation. In this way, forced ventilation controls indoor air quality so that excess humidity, smells and contaminants are diluted or removed.

A mechanical exhaust typically controls odours, vapours, airborne greases and humidity in kitchens and bathrooms. To obtain the best effect with the maximum energy efficiency, it is important to take into account flow rates (function of fan speed and exhaust vent size), and noise levels. Any exhaust ducting crossing unheated spaces should be insulated to prevent condensation on or in the ducting.

Ceiling fans don't provide ventilation, merely circulating air within a room. They reduce the perceived temperature because they help evaporate perspiration, but ceiling fans can keep rooms warmer in winter by helping to move warm air downwards from the space close to the ceiling.

Larger fans and AHUs can form part of building HVAC systems, and there are also 'hardened' industrial fan types, which range in size from the small to the very large.

Whole-house ventilation

Whole-house cooling is a sub-division of mechanical ventilation. It operates by drawing fresh air from open windows and expelling the exhaust air through the attic and roof. Such systems can substitute for air conditioning for most of the year. Whole-house fans should provide houses with 30 to 60 air changes per hour which, combined with ceiling fans and other circulating fans, can provide good domestic summer comfort.

With Part L of the Building Regulations in mind, to obtain the highest energy efficiency, modern homes should be fully insulated, be built as close as possible to airtight standards, and should be fitted with a central ventilation system incorporating heat recovery. >

Vent-Axia's Vent-A-Light shower fan now has an energy saving 3W LED lamp and uses a significant 90% less power than a standard dichroic lamp

Ventilation can be intermittent or continuous. To compensate for lower operating times, intermittent operation requires the whole-building ventilation fan to operate at a higher flow than for continuous operation, so such systems need a programmable timer for control. Today, the trend is towards continuous low-speed operation. This can meet the need for both local exhaust and whole-building ventilation.

There are various types of whole-house ventilation system – with a sometimes confusing number of different names – such as demand energy recovery ventilation system (D-ERV). One of the most important is mechanical ventilation with heat recovery (MVHR). Fresh air is continuously drawn into the home by a low-energy ventilation unit, typically mounted within the roof space or utility room. Once passed through the unit's heat exchanger, warm, clean, fresh, filtered air is distributed through ducting running to bedrooms and living rooms etc.

MVHRs can recover up to 95 per cent of the heat lost through open windows, trickle vents and extractor fans found in buildings, so as the move towards 'zero-carbon' homes gathers pace, they are gaining a foothold.

Standard Assessment Procedures (SAPs) are the government's recommended system for measuring the energy performance of residential dwellings and are cited as such in Part L of the Building Regulations. As Vent-Axia has said, "every point counts", and with SAP calculations, even half a point could contribute to a pass or fail in terms of the Dwelling Emission Ratings (DER).

Moving towards the government's zero-carbon home target specification becomes harder as efficiency rates attain their maximum, yet as buildings become increasingly air-tight, it is more important than ever to ventilate effectively. Such considerations are driving the increasing adoption of MVHR systems, which provide a business opportunity for enterprising electrical contractors – following suitable training.

This is the background to legislation and technology designed to ensure healthy indoor air quality in tomorrow's new homes, especially as improvements to Building Regulations Part L require new homes to be built to increasing standards of air-tightness.

Electric heating

Electric heating, which is any process where electrical energy is converted to heat, has applications in water heating, space heating, industrial processes and cooking, among others. In this article, the focus is on water and space heating.

Ignoring the electrode-type of electric water-heating, which can have safety issues, the main type of heating is still mostly immersion, in which a hot water cylinder contains an insulated electric resistance heater and a temperature sensor. Although some manufacturers say otherwise, all electric resistance heaters are 100 per cent efficient at the point-of-use – all the electrical energy is converted to heat.

There are also tank-less heaters and electric showers, in which the immersion heater is turned on by water passing through and turned off when the flow is stopped.

Electric space-heating systems comprise domestic electrical underfloor types, plus radiative, convection, fan and storage varieties. Note that off-peak storage heaters for a given property will always be cheaper to run over a 16-hour day than an electric convector heater or radiator using the standard rate electricity.

With underfloor heating, electric current flows through a flexible conductive heating element (cables, pre-formed cable mats, bronze mesh and carbon films). Because of their low profile, they can be installed in a thermal mass, or directly under floor finishes. Either 110V or 230V, or extra-low voltage (8 to 30V) is applied to the electrical resistance heating element. The control unit typically contains a step-down transformer; a floor thermostat controls the pre-set temperature. The floor heats the air, which circulates, heating the room spaces etc. Underfloor heating generally provides the most consistent room temperature from floor to ceiling compared with other heating systems.

Heat pumps provide another means of heating and cooling, a building using electricity. An electric motor drives a refrigeration cycle, drawing heat energy from a source (usually the ground or external ambient air), and then pumping it into the space to be heated. This is a reversible process, so heat pumps can also be used to cool spaces. Although heat pumps will not be suitable for every application, they are very energy-efficient and are sometimes labelled 'sustainable', contributing to their growing popularity.

Modern control strategies

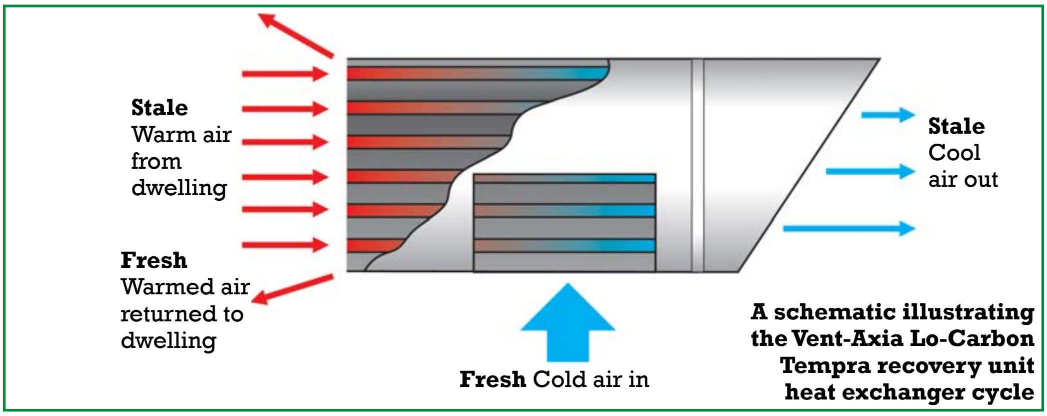
Electric heating technologies may be for the most part mature, but just as with ventilation products, the drive for energy-efficiency is bringing significant improvements to the control of heating devices and systems. For example, responsiveness reflects the ability of the heater to match the heating needs of a home, which is important, not just from the perspective of being able to warm a space well, but also from an energy-efficiency perspective.

High energy-efficiency and responsiveness combined with modern controls mean that, for example, users of storage heaters can use the stored heat as and when they need it. This is changing the peak / off-peak split of energy usage in storage heating. Being able to harness low-carbon, low-cost electricity saves end-users money and supports demand-side management. Dimplex is one company taking advantage of this with its new Quantum storage heater and sophisticated control system.

And finally…

This article has provided a brief overview of some of the HVAC technologies and related issues that the Voltimum UK 'Electrical Heating, Ventilation & Control Expert Panel' will be examining in detail. The work of the Expert Panel will be covered, in part, through the award-winning e-newsletter VoltiTECH, which covers topical technical and legislative issues. Nearly 120 editions of VoltiTECH have been produced since its launch in June 2003. One of the most recent was entitled 'Heating and ventilating, and the new HVAC Expert Panel introduced'. This article is based on the content of this issue, all provided by the Expert Panel.

James Hunt is the managing editor of the UK arm of the Voltimum UK electrical web portal



A schematic illustrating the Vent-Axia Lo-Carbon Tempra recovery unit heat exchanger cycle