Information Guide

Ventilation and indoor air quality

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MITSUBISHI ELECTRIC
LIVING ENVIRONMENTAL SYSTEMS

Guide to ventilation and indoor air quality

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today. The guide accompanies a series of seminars, all of which are CPD accredited.

As 90% of our time is spent indoors (according to the World Health Organisation), good air quality both at home and in the workplace, is essential. Poor quality air can lead to a lack of concentration, or even physical symptoms such as sore eyes and respiratory problems.

As there is a technical definition of indoor air quality (IAQ), thermal comfort, breathability and removal of pollutants and contaminants can be monitored to ensure conditions are as comfortable as possible for the occupants. However, maintaining the balance between energy efficiency and good ventilation is an ongoing challenge.

CONTENTS

1. The importance of good air

There can be little doubt that the quality of air in homes and work environments is important to occupant health and comfort. Figures from the World Health Organisation (WHO) show that we spend around 90% of our time indoors, at work or at home. Achieving a good quality of air in those spaces is therefore vital.

Most people can quickly tell if a room is too hot, or 'stuffy', but there is a useful technical definition of indoor air quality (IAQ). Indoor air should satisfy three basic needs of occupants:

– Thermal comfort
– Breathability
– Removal of pollutants and contaminants

Temperature, humidity and contaminants are therefore the three important factors to bear in mind when considering ventilation of homes or non-dwellings. Pollutants may be more prevalent than first thought. They include inorganic gases such as carbon monoxide, carbon dioxide or nitrogen dioxide. Carpets, photocopiers and paint can give off contaminants. In poorly ventilated homes fungi and bacteria can be a particular problem.

The health problems associated with poor ventilation vary widely. They range from poor concentration and fatigue all the way to physical symptoms such as sore eyes, skin problems and respiratory issues. Sick Building Syndrome was identified as early as the 1960s as a mixture of these symptoms, caused in the main by poorly designed building ventilation. For businesses, a poorly ventilated building can even cause reduced productivity and higher absenteeism.

School buildings have been particularly well analysed for the effect of ventilation on occupant health. Research by several Universities including Reading and University College London found that in classrooms with high CO_2 levels, students are likely to be less attentive and demonstrate poor concentration.

The problems of poor ventilation in homes have also been studied in-depth, particularly in light of the drive for more energy efficient dwellings. The drive is towards greater air tightness, raising the question of how to attain good IAQ. There are a surprising number of pollutants in the home, arising from products such as cleaning solutions, carpets and vinyl flooring. These, along with excess humidity, need to be removed. Mechanical ventilation looks set to be used more widely in UK homes as a result.

Figures from BRE show that ventilation and cooling can account for around 11% of carbon emissions by end-use in UK non-domestic buildings. This can vary according to the type and design of the building (factors include thermal insulation, building services system efficiencies and occupancy behaviour), however it is still a substantial proportion.

With the drive for more energy efficient buildings the challenge for designers, installers and building users today is to find ways to ensure good ventilation that is also energy efficient.

Our next features will examine the latest guidance and legislation on ventilation.

2. Ventilation and regulation

With an update of Part L of the Building Regulations in 2010, changes to Part F were also introduced. This section of the Building Regulations deals with ventilation of domestic and commercial buildings, and should be regarded as very important by designers, installers and building operators alike.

It is important to note how the demands of Part L impact on the requirements of Part F. Part L 2010 sets new and higher targets for air tightness in dwellings and non-domestic buildings. The aim is to reduce the requirement for heating, a large contributor to the UK's carbon emissions. However, better air tightness means that designers must find new ways to ensure good ventilation is achieved.

The main aim of the requirements of Part F 2010, "is that a ventilation system is provided that under normal conditions is capable of limiting the accumulation of moisture, which could lead to mould growth, and pollutants originating within a building which would otherwise become a hazard to the health of the people in the building".

For the purposes of Part F 2010, a reasonably high level of air tightness must be assumed. The legislation states that: "Through good design and execution, domestic and non-domestic buildings can currently achieve an air permeability down to around 2 to 4 $m^3/(h.m^2)$ of envelope area at 50 Pascal (Pa) pressure difference. It can be assumed that there will be a continual trend towards more airtight buildings due to drivers for higher energy efficiency and lower carbon emissions".

Under Part F, ventilation is defined as the removal of 'stale' air from a building, and replacing this with 'fresh' outside air. The aim is to remove airborne pollutants including odours; to control excess humidity; and to provide outside air for breathing. Ventilation is also a method for controlling indoor temperatures, and this use is covered by Part L 2010 (summer overheating).

Part F offers designers a number of approaches to ensure their building meets its requirements. The legislation highlights extract ventilation for rooms where most water vapour or pollutants are released (for example bathrooms and kitchens); whole building/dwelling ventilation to provide fresh air to the building and disperse residual water vapour and pollutants not dealt with by extract ventilation; and purge ventilation throughout the building to aid removal of high concentrations of water vapour and pollutants caused by activities such as painting and decorating or accidental releases such as burnt food. These strategies can be delivered by natural ventilation, mechanical ventilation or a combination of both – a hybrid system.

One of the most important points to remember is that while developers must comply with Part F, they also need to ensure that their designs and buildings are acceptable under the Standard Assessment Procedure (SAP). This was also updated fairly recently, to include an Appendix Q, which encourages greater use of energy efficient ventilation systems, such as mechanical heat recovery ventilation (for example the Lossnay system from Mitsubishi Electric).

Another important aspect of Part F 2010 is that for the first time post-completion testing of ventilation equipment is a legal requirement.

A new Domestic Ventilation Installation and Commissioning Compliance Guide has been published.

The aim is to ensure that ventilation systems operate effectively, quietly and energy efficiently. Our next feature will consider two approaches to achieving these requirements.

Summary of Part F 2010 updates

1. Fixed mechanical ventilation systems must be commissioned and a notice given to Building Control.
2. Air flow rates of mechanical ventilation systems (including intermittent systems in bathrooms or in kitchen extracts) installed in new dwellings must be measured on-site and a notice given to Building Control.
3. The building owner must receive sufficient information about the ventilation system, and any maintenance requirements, to ensure long-term energy efficient operation.
4. Background ventilation rates for dwellings with infiltration rates lower than $5m^3h/m^2$ at 50 Pascals (Pa) have been increased.
5. Part F 2010 includes guidance on ventilation systems for refurbished kitchens and bathrooms.
6. The diameter of passive stack ventilators is increased to 123mm.

3. Achieving the balance: ventilation and energy efficiency

Achieving good indoor air quality in an energy efficient way is now a key issue that designers and installers need to address in both domestic and commercial buildings. However, legislation is descriptive rather than prescriptive, so designers can select from a number of solutions.

Mixed mode In commercial buildings, the choice for cooling and ventilation in the past has been viewed as either mechanical or passive. However, it is now possible to achieve a hybrid solution that combines the best of both options. Mixed-mode ventilation and cooling systems use passive techniques to bring in fresh air to a building, switching to mechanical air conditioning only when environmental factors require it. Natural ventilation can be achieved using cross-flow or passive stack systems. The first draws air across a building. The rule of thumb (as recommended by CIBSE) is that the maximum distance between two facades is five times the floor-to-ceiling height. Cross-flow is therefore useful for narrow-plan office buildings, or buildings where there is a central open space.

Passive stack ventilation uses the natural buoyancy of warm air and the driving forces of wind to create a flow of air across occupied space. Cool air is drawn up through the building and exhausts vertically.

System performance can be enhanced by designing-in a glazed chimney that is warmed by the sun. These chimneys help to draw fresh air through the building. In larger, deeper buildings a central atrium can also be used in the same way. However, an atrium is not designed specifically for ventilation and extraction and may well be occupied so designers must bear in mind the issue of potential overheating in this area. An important aspect of natural ventilation is night cooling. The building is 'flushed' of any remaining warm air by allowing cool night air to enter the building when it is unoccupied. In summer this is a useful technique for reducing overheating during the day.

Entirely naturally ventilated buildings do use less energy than those employing mechanical methods. However, in spite of their environmental credentials, naturally ventilated buildings are prone to overheating, particularly in summer. A natural ventilation system can usually deal with heat loads of around 40W/m^2 – often half the level experienced in a typical office building.

Not only is this uncomfortable for occupants, but Part L also requires that buildings do not overheat. Clients also want a predictable indoor environment, which is more difficult to achieve through natural ventilation.

With these issues in mind, mixed mode ventilation offers an excellent solution: natural ventilation offers excellent IAQ, combined with air conditioning that can ensure overheating is not a problem.

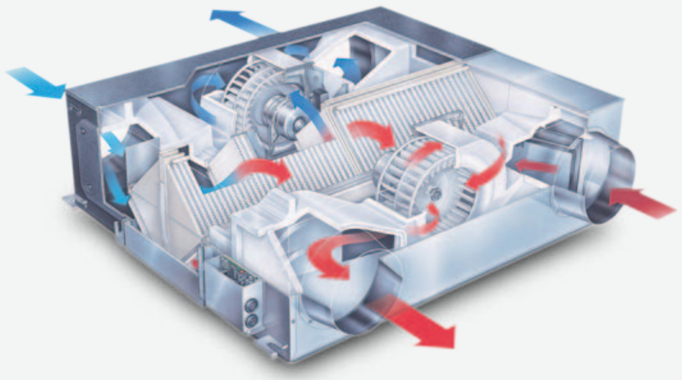
By using automated controls to track indoor and external temperatures, a mixed mode system switches from natural ventilation to air conditioning in order to keep the building within set temperature parameters. This can either be done throughout the year (a concurrent mixed mode system) or with natural ventilation-only during mild months (changeover mixed mode).

Heat recovery One technique which is becoming increasingly popular with designers is a ventilation system with heat recovery capability because it offers good ventilation with excellent energy efficiency. Such systems are now readily available for both domestic and commercial buildings. These heat recovery units reduce the overall energy costs by extracting stale air from the building and recovering the heating or cooling energy to either warm or cool incoming fresh air.

Using this method a good heat recovery ventilation system can save up to 30% on initial capital costs of heating and cooling plant, as well as giving excellent long-term lowered energy costs.

In winter, warm, stale air is extracted from a building and passes over a diaphragm of specially processed paper. At the same time, cold air is introduced to the system from outside. It too passes over the diaphragm where heat is exchanged and the fresh air temperature is raised before entering the building.

In summer, cooled air from an air conditioned office is extracted and crosses with warm air being drawn into the building. The external air temperature is cooled before it enters the cooling system, thereby lowering energy requirements of the air conditioning units. The diagram below shows a Mitsubishi Electric Lossnay heat recovery unit.



Further information

If you missed the CPD seminar on **Ventilation and indoor air quality** you can call your Mitsubishi Electric Regional sales office to arrange an in-house presentation of this information.

If you would like to receive invitations to future CPD events, please email **lesmarcomms@meuk.mee.com**

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MITSUBISHI ELECTRIC
LIVING ENVIRONMENTAL SYSTEMS

Telephone: **01707 282880**
email: lesmarcomms@meuk.mee.com web:www.mitsubishielectric.co.uk
UNITED KINGDOM Mitsubishi Electric Europe Living Environmental Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England.
General enquiries Telephone: 01707 282880 Fax: 01707 278674
IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland.
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)