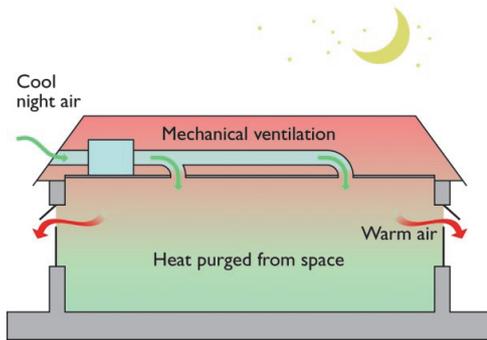


Ventilation and Air Movement



Introduction

Ventilation is the supply and removal of air to and from a space or spaces in a building. Ventilation might be needed for a variety of reasons, including: removal of pollutants and water vapour, or for temperature control. There are requirements in the *2010 Building Regulations* for ventilation, with particular reference to *Approved Document F* and *Approved Document J*.

Why is ventilation important?

Indoor activities may produce pollutants, excess heat or water vapour that need to be removed for occupants' health and comfort. Ventilation is thus important in order to:

- ⇒ Maintain a reasonable quality of indoor air (for example by removing pollutants and odours)
- ⇒ Control the temperature of a room or building (for example controlling the heat from solar gain)
- ⇒ Address moisture problems in dwellings with low levels of air leakage or uneven insulation.

Specialised ventilation is needed in spaces such as: kitchens, operating theatres, mortuaries, clean rooms, laboratories, theatres, cinemas, and enclosed car parks, and for activities such as welding, paint-spraying, mining.

It is important to note that ventilation systems must not increase the hazard of spreading fire or smoke gases.

How does ventilation work?

Ventilation can be achieved by mechanical means, by natural ventilation, or a combination of these methods (called 'mixed-mode'). Mechanical ventilation uses fans to force air to flow through a building. Natural ventilation may be achieved by opening windows, trickle vents, or other purpose-provided openings. Trickle vents provide a small amount of natural ventilation when other means of ventilation such as windows and doors are closed. On a larger scale, roof-mounted natural ventilation systems can deliver good comfort conditions at low levels of energy consumption.

Brief history of ventilation

Early ventilation technology included the use of bellows in ships, hospitals and prisons. The use of heat for ventilation 'can be traced back to the mines of Saxony in the 16th century' and the first recorded use of ventilating fans is believed to be 1556 (CIBSE, 2008).

Fans for mechanical ventilation were introduced around 1850, being driven by gas or steam engines. Fans driven by electric motors were used from the early 20th century. In 1897, the Institution of Heating and Ventilating Engineers (IHVE) was founded, the forerunner of CIBSE.

The American Society of Heating and Ventilating Engineers (ASHVE – now ASHRAE) proposed a figure of 50 m³/h per occupant of fresh air in 1914. This rule was studied and revised over the years, later becoming standard. The *Building Regulations 2010* require that adequate means of ventilation is provided. *Approved Document F* gives guidance on ventilation rates.

Good ventilation has also been developed as a means of reducing the spread of diseases. *Coughs and sneezes spread diseases* was the title of a 1943 British Ministry of Information newsreel trailer encouraging people to use a handkerchief to stop the spread of diseases through airborne infection.

Types of ventilation systems

Natural ventilation makes use of the forces of wind and differences in air temperature to move air through the building, and includes:

- ⇒ Single-sided ventilation (adequate for shallow-plan buildings)
- ⇒ Cross ventilation (drives air through open windows on the windward side of the building)
- ⇒ Passive stack ventilation (relies on the temperature difference between the outside and inside of a building).

Books, reports and guides

Ventilation resources are available to BSRIA members at <https://infonet.bsria.co.uk/>. Search with keywords including 'ventilation', 'indoor air' or 'air pollution' or 'air quality'.

Design checks for HVAC - A Quality Control Framework (Second edition), BG 4/2007, BSRIA, 2007

HVAC design guidance presented in a format that can be easily incorporated into quality assurance systems, and become part of the daily routine of design

Guide to Part F of the Building Regulations: Ventilation, RIBA, 2010

Guidance on ventilation of buildings which are constructed to high standards of airtightness to conserve energy

Guide to Part J of the Building Regulations. Combustion Appliances and Fuel Storage Systems, RIBA, 2010

Help for architects and those specifying the design and choice of heating system

Heating and Ventilation Systems. Health Technical Memorandum 03-01: Specialised Ventilation for Healthcare Premises. Part A: Design and Validation, Part B: Operational Management and Performance Verification, Department of Health

Guidance on the legal requirements, design implications, maintenance and operation of specialised ventilation for healthcare premises

Historic Building Engineering Systems and Equipment: Heating and Ventilation. CIBSE Heritage Group, 2008

www.helm.org.uk/upload/pdf/HeatingVentilation.pdf?1292072979

Indoor air quality guide: best practices for design, construction and commissioning. USE ASHRAE, 2009

Focuses on moisture management, ventilation, filtration and air cleaning

The Illustrated Guide to Ventilation. BG 2/2009 BSRIA, 2009

Quick reference guide to effective ventilation, by mechanical, natural or mixed-mode, to provide a comfortable, healthy and productive working environment

Wind-Driven Natural Ventilation Systems. BG 2/2005 BSRIA, 2005

Guidance on the design and application of wind-driven natural ventilation systems, which can deliver good comfort conditions at low levels of energy consumption

Legislation and guidance

England and Wales *Building Regulations Approved Document F – Ventilation (2010 edition)*

England and Wales *Building Regulations Approved Document J - Combustion appliances and fuel storage systems (2010 edition)*

Mechanical ventilation removes the need to rely on external driving forces. It includes:

- ⇒ Extract ventilation
- ⇒ Commercial kitchen extract systems
- ⇒ Toilet and bathroom extract systems
- ⇒ Underground car park ventilation systems
- ⇒ Factory or industrial building ventilation systems
- ⇒ Localised industrial extraction systems
- ⇒ Supply ventilation systems
- ⇒ Fire and smoke ventilation systems.

Mixed-mode ventilation consists of using both natural and mechanical ventilation. Strategies for mixed mode ventilation include:

- ⇒ Contingency (mechanical ventilation is installed to provide in-use flexibility)
- ⇒ Zoned (some areas are supplied with mechanical ventilation)
- ⇒ Changeover (a mechanical system for summer/winter and natural ventilation for spring/autumn)
- ⇒ Parallel (both methods used simultaneously).

Purge ventilation removes warm or polluted air at periods of low occupancy, typically at night. This cools the thermal mass of the building and can reduce the cooling demand and peak daytime temperature.

Commissioning and maintenance

The proper commissioning of ventilation systems is a building regulations requirement. Commissioning procedures can include: preliminary checks, regulation of airflow adjustment, and the preparation of commissioning documentation.

BSRIA Guide, BG 3/2004 *Business-Focused Maintenance*, recommends a maintenance regime for a mechanical ventilation system. Guidance concerning the cleaning of ventilating systems is given in the HVCA guide *TR/19 – Internal Cleanliness of Ventilation Systems*, including visual and quantitative monitoring, and dry and wet cleaning methods.

Legal requirements

Key considerations for ventilation include health, energy and noise of the air handling units.

Ventilation rates: *Approved Document F* prescribes ventilation rates but under certain conditions allows for a performance-based approach. For example, the extract rate for rooms containing printers and photocopiers in substantial use is 20 l/s per machine.

Maintenance: The maintenance required will depend on the type and application of the ventilation system. The *Workplace (Health, Safety and Welfare) Regulations* impose a duty to clean mechanical ventilation systems ‘as appropriate’.

Local exhaust ventilation (LEV): The HSE states that ‘employers must ensure that thorough examination and testing of their protective LEV is carried out every 14 months (unless otherwise stipulated)’ (p 65, HSG 258).

Carbon monoxide: *Approved Document J* includes a provision for ventilation for combustion appliances – in particular to enable normal operation of appliances without the products of combustion becoming a hazard to health.

Energy conservation: All modes of ventilation, including natural, have to strike a balance between air quality, thermal comfort and minimising energy usage.

Noise: *Approved Document F* states that ‘the noise caused by ventilation systems is not controlled under the *Building Regulations* [...] however] it is recommended that measures be taken to minimise noise disturbance’. However, external noise may preclude the use of natural ventilation in some circumstances. There may also be local planning requirements regarding noise to consider.

Historic buildings: *Approved Document F* recommends ‘taking into account the advice of the local authority’s conservation officer’. This is particularly for planning permission or listed building consent. English Heritage guidance and *BS 7913 Principles of the conservation of historic buildings* should be referred to when determining appropriate ventilation strategies.

Scotland: *Building Standards Technical Handbook - Domestic 2010. Section 3.14 (Environment)*

Scotland: *Building Standards Technical Handbook - Non-Domestic 2010*

Northern Ireland: *Building Regulations (Northern Ireland) 2000 Part K: Ventilation*

Control of Substances Hazardous to Health (COSHH) Regulations 2002

Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV), HSE, HSG 258, 2008

Workplace exposure limits, HSE Books, EH40/2005

Standards

Ventilation for buildings: ducts and ductwork components, leakage classification and testing, BSI, BS EN 15727:2010

Applies to technical ductwork products

Ventilation for buildings. Fire precaution for air distribution systems in buildings, BS EN 15423:2008

Guidance for system designers, installers, commissioners and maintenance teams on the incorporation of protective measures for air distribution systems

Ventilation for acceptable indoor air quality. USA ASHRAE, ANSI/ASHRAE Standard 62.1-2010 Specifies minimum ventilation rates and indoor air quality that will be acceptable to human occupants

Specification for kitchen ventilation systems, HVCA, DW/172, 2005

Specifies design recommendations for commercial kitchen ventilation systems

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BSRIA Information Centre. BSRIA members can borrow books, standards, journal articles and other items from our extensive technical collections. Visit www.bsria.co.uk, email information@bsria.co.uk or call (+44) (0)1344 465571. We’re open 8.30 – 5.00pm Monday to Thursday, 8.30 – 4.30pm Friday.

BSRIA’s Test and Microclimate services include troubleshooting for HVAC systems, investigating levels of thermal comfort, testing chilled beams, and mock-ups of office spaces. Email test@bsria.co.uk

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