



NATURAL VENTILATION STRATEGIES

FOR COMMERCIAL BUILDINGS



NATURAL VENTILATION

The low-energy strategy

Low-energy natural ventilation is an increasingly important design strategy for commercial and other non-domestic buildings.

In comparison with air conditioning or mechanical ventilation it can bring:

- Economic benefits through savings in both capital equipment and running costs.
- Environmental benefits in reducing energy use and cutting greenhouse gas emissions and CO₂ levels.
- User benefits in providing controlled, comfortable conditions.

Intelligent solutions

Current technology and design software combined with sophisticated control systems mean that natural ventilation can provide optimum performance as well as the benefits indicated above.

Using the latest techniques, intelligent natural ventilation solutions can be applied to many buildings that would otherwise have defaulted to air conditioning.

Hybrid Plus systems can also be used for pre-warming incoming air in winter periods by mixing air and in summer months, they create airflow in times of low air movement.

Early consultation

The key to the successful implementation of a natural ventilation strategy is to consider its application during the preliminary stages in the design of a building (preferably at outline proposal stage). Decisions about building plan, orientation and other factors will enable the most effective use to be made of natural ventilation.

Clients, developers and building designers should therefore consult natural ventilation experts such as Passivent as early as possible in the design process.

PASSIVENT

Passivent services

Designing natural ventilation systems to be as efficient as possible requires specialised expertise.

With its in-house research and design team, Passivent can provide a comprehensive design and advisory service tailored to specific projects, covering both system design and product selection from a range of complementary ventilation strategies.

Passivent expertise

Passivent are specialists in delivering natural ventilation solutions, and a leading UK company in the field of sustainable and energy-efficient ventilation for commercial buildings.

A pioneer in natural ventilation, Passivent has been at the forefront in developing innovative products and systems to provide optimum performance in all types of buildings. Combined rooflight/ventilators complement Passivent's natural ventilation range.

Passivent design software

With so many variables in natural ventilation design it is important to understand how the elements interact with each other within the context of the building.

A key part of the NatVent™ research project (see overleaf) has been the production of software to assess the various forms of natural ventilation in different types of building.

Following on from this Passivent has developed its own advanced software 'AirSoft™' (based on CIBSE AM10) to provide an integrated design approach that takes account of all facets of the ventilation requirement. This software is used to calculate sizes of air inlets and outlets to achieve optimum performance.

Passivent products

Passivent has developed a range of products (including acoustically treated and hybrid plus options) which can be incorporated into natural ventilation systems for commercial buildings. More information on these is available on request.

Passivent Products are also embedded within EDSL's TAS programme for ease of thermal modelling.



THE BACKGROUND

The NatVent™ project

NatVent™ was an EC/EU-funded project involving nine partners in seven countries, co-ordinated by the UK Building Research Establishment and published during 1999. Passivent, as one of the NatVent™ partners, has taken a leading role in developing practical solutions for the commercial building sector. Passivent have been providing solutions to clients since.

The NatVent™ group has carried out an in-depth study of natural ventilation and found that it is an effective design strategy for office buildings in the UK and other European countries with a moderate climate.

Benefits

The many benefits of naturally ventilated buildings identified by the NatVent™ project include:

Cost efficiency

- Naturally ventilated buildings typically consume less than half the energy used in air-conditioned buildings.
- Initial capital costs are also lower, typically by 15%.
- Operating costs can be 40% less in terms of energy consumption.
- Due to simplicity and durability of the components, costs are spread over a longer lifetime.
- Maintenance costs are significantly lower.
- Less space is required for plant rooms and services distribution.

Productivity gains

- 90% of building occupants prefer naturally ventilated buildings.
- Fewer incidents of sick building syndrome are reported.
- Occupants are provided with control over their immediate environment.

Environmental gains

- Significant reduction in emissions of the greenhouse gas carbon dioxide (CO₂).
- Avoids using ozone-depleting substances as refrigerants.

CO₂ reduction

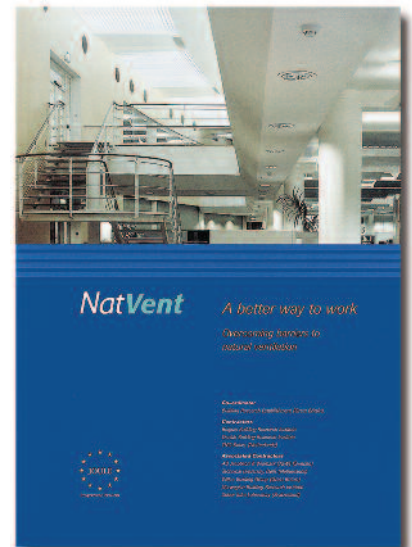
37% of CO₂ emissions in the UK derive from energy consumption in buildings. All buildings, both new and refurbished, must use energy more efficiently to reduce environmental damage. Energy Performance Certificates (EPCs) have been introduced to help improve the energy efficiency of buildings.

Building Regulations Approved Document L Conservation of fuel and power includes performance targets for CO₂ emissions.

System design

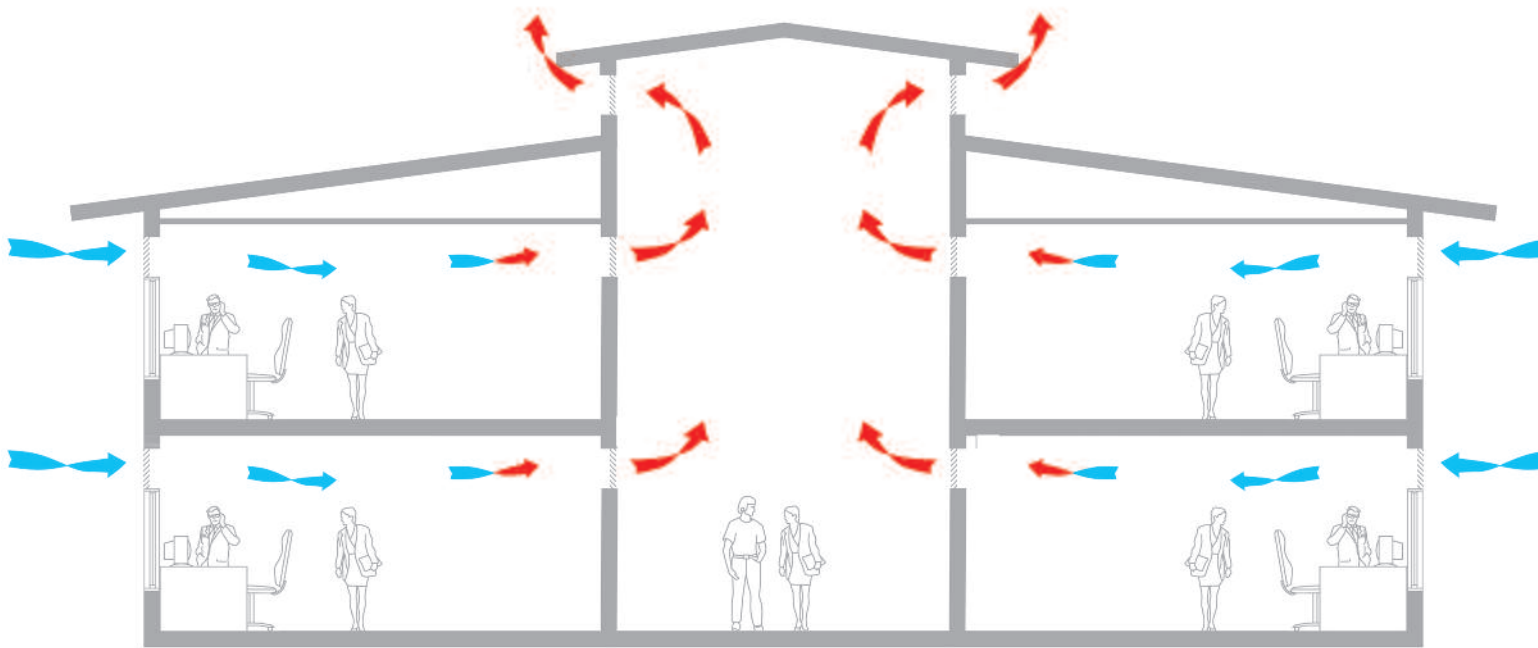
Good design is based on the principle that adequate ventilation is essential for the health, safety and comfort of building occupants, but that excessive ventilation leads to energy waste and discomfort. Building tightness, good ventilation for occupants and natural ventilation design should be considered together for a successful energy-efficient natural ventilation scheme, as set out in Building Regulations.

Strategies have to be developed for winter and summer often requiring different products and control logic. Winter ventilation to maintain good indoor air quality must be balanced against minimising heat losses. Summer ventilation must offset excessive daytime heat gains and provide fresh air distribution.



Since 1999, Passivent have continuously developed our solutions, whilst sticking to the findings of this project.

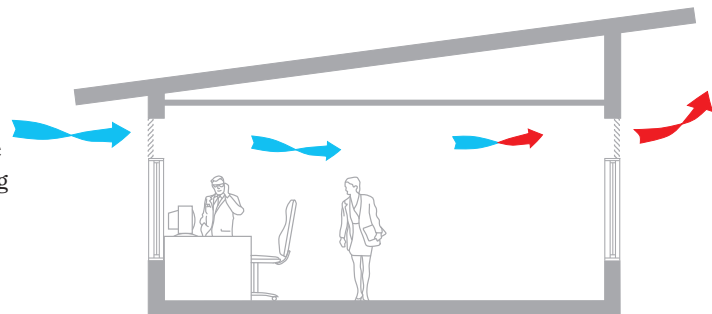
NATURAL VENTILATION STRATEGIES



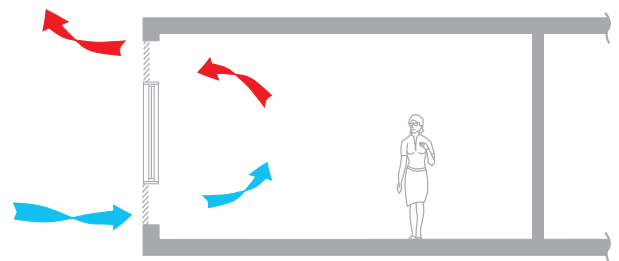
Background ventilation is necessary to provide adequate indoor air quality throughout the year. This can be achieved by various types of façade mounted controllable ventilators often controlled by internal CO₂ levels.

Rapid ventilation is necessary to remove excess temperature from the space and is of prime importance during the summer.

Cross ventilation Cross ventilation achieves good air change rates driven by pressure differences across the building. This method uses controllable high-capacity inlets/outlets on two opposing building façades, and can achieve penetration depths of up to 5 times the floor-to-ceiling height.



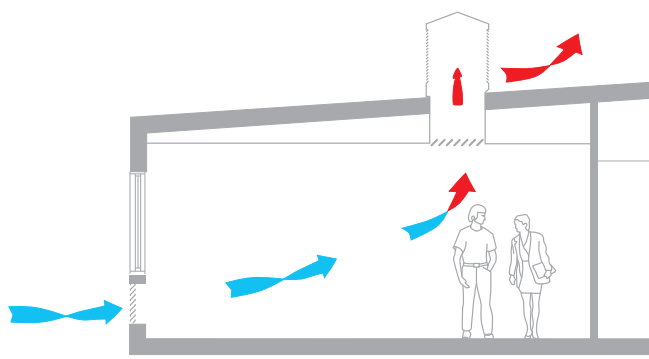
Single-sided ventilation Single-sided ventilation, usually through large façade opening devices, is mainly driven by wind turbulence. Relatively low ventilation rates are achieved except with penetration depths of less than 2½ times the floor-to-ceiling height. Penetration depths are based on typical office low occupant densities and are not applicable to higher occupant densities such as teaching spaces and seminar rooms. Hybrid Plus versions of single sided ventilation systems are available to pre-warm incoming air in winter and assist with airflow during the warmer summer months.



Mixed-mode ventilation Natural ventilation alone may not be suitable for some rooms due to their depth, internal heat loads or other factors. In these cases some mechanical assistance can be incorporated e.g. low powered boost fans in outlets or local comfort cooling devices.

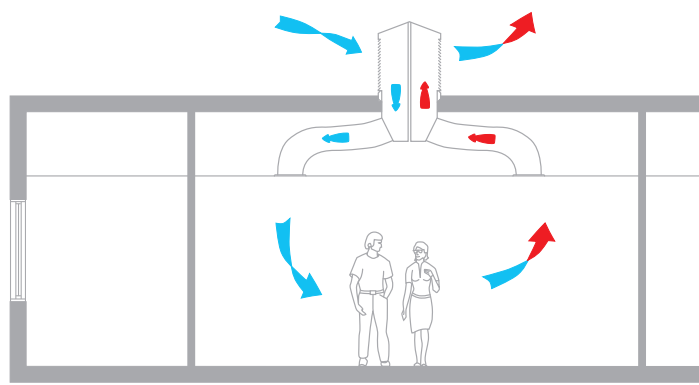
Passive stack ventilation

Passive stack ventilation (PSV) is the most effective natural ventilation strategy as it uses a combination of cross ventilation, buoyancy and the suction effect as the wind passes the terminal. It can ventilate to twice the depth of cross ventilation, up to 10 times the floor-to-ceiling height, as the outlet can be in the centre of a building. It can be an effective night cooling strategy as internal and external temperature differences at night are typically high, so increasing convection. PSV stacks can range from large central atria to local stacks feeding to roof-mounted terminals. Hybrid Plus versions of passive stack ventilation systems are available to pre-warm incoming air in winter and assist airflow during the warmer summer months.



Displacement ventilation

Displacement ventilation uses wind driven roof-mounted terminals with separated chambers to channel air down into the building regardless of wind direction. The cooler, denser air displaces warmer, lighter air upwards, which is drawn out through the leeward chambers of the terminals. This method can be used as part of a night cooling strategy.



Night cooling

Night cooling uses the lower external temperatures at night to reduce the temperature of the building fabric, by means of automatic ventilation devices. The cooled thermal mass of the building is used the next day to reduce internal temperatures. It is best suited to heavy weight structures. A night cooling strategy in a suitable building design can reduce peak internal temperatures by 2 - 3°C the following day. Natural night cooling by lowering the ambient temperatures can delay the use of energy consuming cooling equipment.

SYSTEM CONTROL

An efficient and effective natural ventilation system should move air through the building in a carefully designed manner. The sizing and positioning of inlets, stacks and outlets are critical in achieving the correct ventilation performance. Control of systems is also important to ensure maximum effectiveness and provide the correct level of ventilation at minimum energy cost.

Control components are available from Passivent that vary from simple occupant controlled devices to intuitive systems triggered by sensors which detect temperature and CO₂, matching ventilation to demand. These can be integrated with an overall building management system (BMS) via our intelligent controls system.

SUSTAINABLE BUILDING DESIGN

Sustainability can be best defined as “improving the quality of life for all without damaging the environment or the ability of future generations to meet their own needs” Vision 21.

Sustainable buildings will encompass all facets of design but include natural ventilation, optimum use of daylighting, high thermal mass, solar shading, improved levels of insulation, use of renewable/ recyclable materials and effective lighting controls.

It is important that all members of the design team sign up to the achievement of a common project environmental policy, which acknowledges a commitment to maximise the environmental potential within reasonable constraints. Guidance documents such as BREEAM can lead a project to produce a successful and sustainable ‘green building’.

The generic project illustrated opposite demonstrates many of the ventilation and daylight considerations required to achieve a sustainable building.

Ground and First Floor Ventilation (illustrations 1 and 2 opposite)

The inlet path for natural ventilation is via openable high-level façade devices and windows. The high level openings allow fresh air to pass into the ceiling void and then into the space below. This strategy provides cooling of the structure at night during summer months as well as tempering incoming air the next day. In winter this eliminates sources of draughts by opening windows, as the fresh air passing through the ceiling is prewarmed. A degree of external acoustic attenuation is also provided via the ceiling void. The openable windows are used to boost the ventilation rate, whilst providing additional user control of their own environment.

The façade and ceiling outlet louvres are insulated, so closure at night and during the morning warm-up period reduces heat loss, during cooler periods. These motorised louvres are controlled automatically with manual override facility, to allow user interface.

The room with higher internal heat gains has been located on the lower floor of the North façade as this experiences the lowest solar gains. A boost fan or comfort cooling can be incorporated to provide a mixed mode strategy during warmer weather. The roof-mounted terminals provide large fixed openings with Class-A rain rejection performance.

Daylighting and Corridor Ventilation (illustration 3 opposite)

External southerly solar shading reduces the external solar gains in summer, whilst the building orientation maximises passive heat gain in winter. Tubular rooflights allow natural daylight to enter the rear of the rooms. The reduced window area on the South façade, together with solar control glazing, reduces external heat gains. Daylight control is used with efficient artificial lighting to reduce energy usage.

Ventilation of the corridor is achieved using insulated openable façade devices at either end. The air is exhausted via high level openings in the glazed façade. These motorised louvres are controlled automatically.



Illustration 1
Ground Floor Ventilation

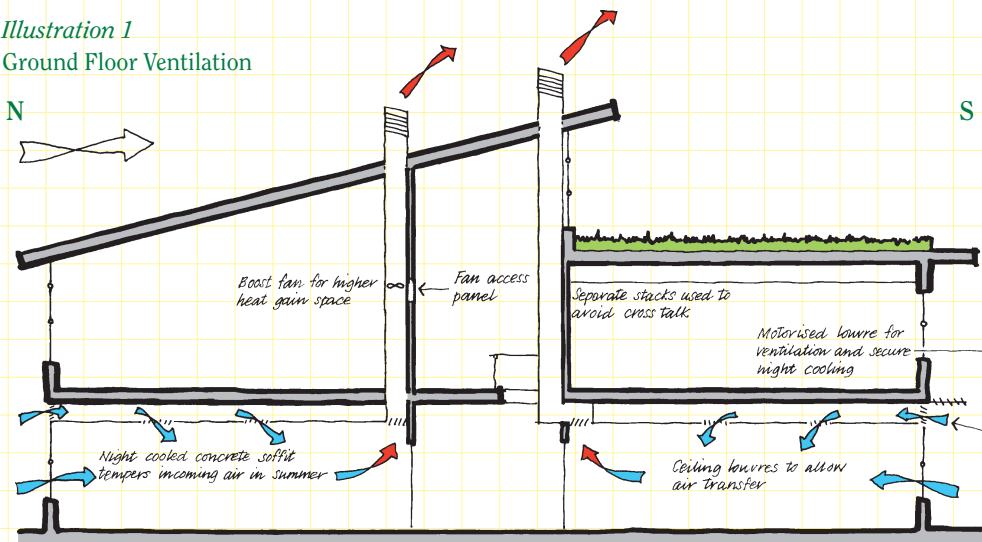


Illustration 2
First Floor Ventilation

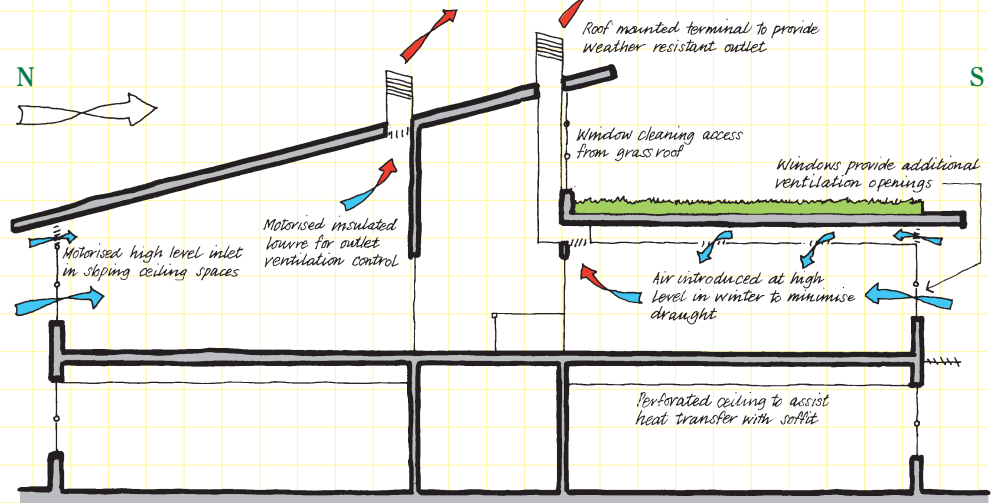
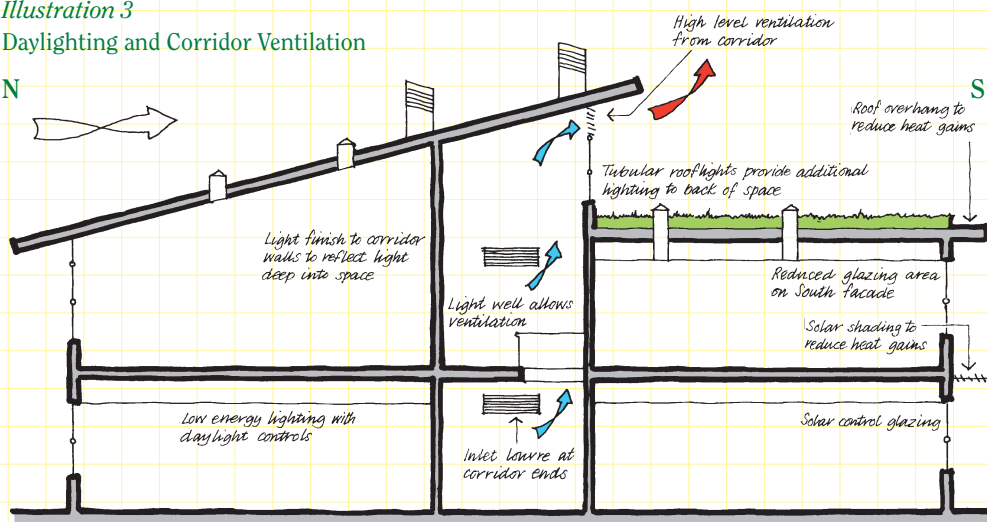


Illustration 3
Daylighting and Corridor Ventilation



Illustrations based on a design produced by
Stride Treglown Davies

FURTHER INFORMATION

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Services

Passivent offers a comprehensive design and advisory service tailored to your specific project, covering ventilation design and product selection. Advanced software based on CIBSE AM10 is used to calculate sizes of air inlets and outlets to achieve optimum performance.

Names of approved installers can be provided on request.



Quality assurance

Passivent is committed to the continuous improvement in the quality of its products, service and method of operation.

Its products are designed, developed and manufactured under the ISO 9001 quality management system, providing an independently audited assurance that the products will fulfil their intended purpose. The company also works to an occupational health and safety (OH&S) management system and has been accredited to the international standard ISO 45001.

Environment

Passivent conducts all business processes under the international ISO 14001 quality management system, giving an assurance that all activities are carried out having minimal impact upon the environment.

Other products

Passivent sells a range of other ventilation and daylighting products for commercial and domestic buildings including:

Natural ventilation systems.

Aircool® ventilators for windows, curtain walling and walls.

Airstract® roof terminals for passive stack and other natural ventilation systems.

Airscoop® wind-driven ventilation terminals.

Litevent combined ventilator and rooflight.

iMEV intelligent mechanical extract ventilation system.

Hybrid Plus2 Aircool® ventilators.

Hybrid Plus Airstract® ventilators.

SoundScoop® acoustic transfer ventilation products.

PASSIVENT

North Frith Oasts, Ashes Lane, Hadlow, Kent TN11 9QU Tel: 01732 850770 Fax: 01732 850949
Email: projects@passivent.com Web: www.passivent.com

Passivent maintains a policy of continuous development and reserves the right to amend product specifications without notice.



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