# BUILDING CPD
# NATURAL VENTILATION

IN THE FIFTH OF OUR REGULAR SERIES OF CPD MODULES, WE LOOK AT THE BENEFITS OF NATURAL VENTILATION AND WHAT YOU NEED TO KNOW TO SPECIFY IT. THIS MODULE IS SPONSORED BY GDL AIR SYSTEMS

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**HOW TO USE THIS MODULE**

Building's free continuing professional development distance learning programme is open to everyone who wants to develop and improve their professional knowledge and skills. These modules can contribute to your annual programme of CPD activity to help you maintain membership of professional institutions and bodies.

All you have to do is read this module and then answer the multiple choice questions on the final page; complete your personal details and fax the page to **020-7560 4014** or scan it and email to **building.cpd@ubm.com**. Alternatively, for a quicker, greener way of completing this module, go to **www.building.co.uk/cpd**
Return your answers by 18 November 2011



*For the £5m refurbishment of the University of Sheffield's Student Union building, GDL supplied a natural ventilation solution where roof-mounted penthouse louvres are used in place of mechanical ventilation in the assembly area*

## INTRODUCTION

The purpose of ventilation is to provide good indoor air quality throughout a building in both summer and winter and to prevent odours from seeping throughout internal spaces. It is suggested by the Chartered Institute of Building Services Engineers (CIBSE) that in all occupied areas, eight litres of fresh air per second per person (l/s/p) should be provided to prevent pockets of stagnant air and address air temperature gains produced by humans, solar radiation and machines. In all other areas, such as corridors and halls, 3l/s/p should be provided. In summer, it may be necessary to provide more than the recommended level to remove unwanted heat gains, and additional ventilation is required where fumes or dust accumulate, such as in kitchens. Poor ventilation leads to damp conditions, a build-up of dust and dirt and the possibility of an unhealthy environment.

## THE IMPORTANCE OF CARBON DIOXIDE MONITORING

**Carbon dioxide is often measured to ascertain indoor air quality. It indicates the number of occupants and if levels of $CO_2$ are high, adequate ventilation is not being provided. Exposure to high levels of $CO_2$ is not dangerous, but may affect performance – some studies have shown it can lead to a lack of concentration and symptoms of sick building syndrome. A build-up of $CO_2$ may indicate a build-up of other contaminants. CIBSE recommends a $CO_2$ concentration of no more than 900 parts per million (ppm) in occupied spaces to control odours and create a comfortable environment. By incorporating $CO_2$ monitoring within a ventilation system, ventilation rates in each area can be designed to be dependent on occupancy. $CO_2$ sensors in a natural ventilation system prevent wastage of energy in buildings where occupancy varies during the day. In summer, ventilation rates will be controlled by temperature sensors, but lower winter ventilation rates will be controlled by $CO_2$ sensors. This limits the fresh air entering the building in order to maintain internal temperature.**

## REGULATIONS

It is fundamental that all buildings, new or refurbished, comply with the relevant regulations. Building Regulations Part F (Means of Ventilation) and Part L (Conservation of Fuel and Power) ensure the adequate provision of ventilation in buildings, good air quality and the avoidance of overheating. The Building Research Establishment's BREEAM scheme is an environmental assessment that ensures the optimum environmental performance of buildings, and produces an overall rating according to the efficiency and effectiveness of all aspects of a building's design, including its services.

## INTRODUCTION TO NATURAL VENTILATION

The fundamental difference between natural and mechanical ventilation is that natural ventilation uses encapsulated wind and solar power to fully ventilate a building. Natural ventilation is driven by wind and stack effects based on outdoor wind speed and indoor and outdoor temperature and pressure differences. In order to maintain a comfortable environment, with the correct air temperature and velocity, a combination of window vents, extract grilles and ventilation turrets or stacks is required. Both temperature and $CO_2$ sensors are also necessary to control ventilation rates. Ventilation demand will change depending on the season and occupancy levels. In a school, for example, occupancy in each room varies throughout the day, so a controlled ventilation rate using natural ventilation would be both cost-effective and energy efficient. Natural ventilation is a popular method of ventilating offices, restaurants and educational facilities, and is particularly effective in open spaces that have a high occupancy, such as warehouses, distribution centres, gymnasiums, sports halls, assembly areas and supermarkets.

## BENEFITS OF NATURAL VENTILATION

■ Cost-effective
Natural cooling eliminates the need for mechanical air conditioning, which leads to low energy consumption, low operating costs and low maintenance costs. Night purging reduces day-time cooling needs by refreshing the room with cooler night-time air, lowering the temperature of the building structure, to provide a comfortable environment for occupants the following morning.

■ Sustainability
Harnessing natural wind power and temperature buoyancy (as air is warmed in an occupied space it rises upwards) to ventilate a building means that no fossil fuels are needed to run mechanical fans, which contributes significantly to energy conservation.

■ Health benefits
A constant supply of cool fresh air eliminates "sick building syndrome", where in a mechanically ventilated building recirculated air can cause occupants to become ill. A continuous supply of fresh air replacing stale air increases concentration levels. By replacing open windows, security risks are also reduced.

## CONSIDERATIONS WHEN SPECIFYING NATURAL VENTILATION SYSTEMS

**When designing a suitable natural ventilation system, it is crucial to understand both wind and buoyancy. Warm air is less dense than cold air. When the two meet, the dense, cold air will fall, displacing warmer air upwards. As warmer air rises and cold air falls within a room, this promotes a flow of air to produce the required ventilation rate. The height and layout of a building will affect its ventilation requirements. There are numerous options to allow for the most effective airflow throughout the building. Natural ventilation systems are not suitable in areas with a high level of pollutants, fumes and odours – eg kitchens, laboratories, toilets and areas with high functional heat gains. Operating theatres also need to be mechanically ventilated so that outside air cannot bring potential pollutants. Mixed mode systems can be used to minimise the cost of a mechanical arrangement by using natural ventilation where possible, and solar-powered systems can reduce energy demand where power-assisted fans are required.**

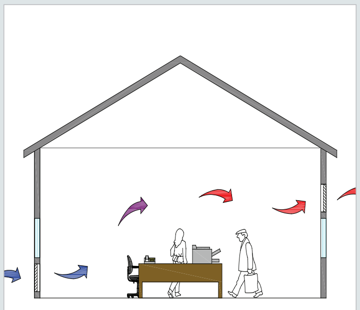
*GDL's Intellivent Wall Mounted units were used in place of mechanical ventilation to supply fresh air throughout the new building for Holte, Mayfield & Lozells School, built to achieve $CO_2$ emissions of just 27kg/m² under Birmingham's Building Schools for the Future programme.*

## TYPES OF AIRFLOW

Natural ventilation systems can use different types of airflow.

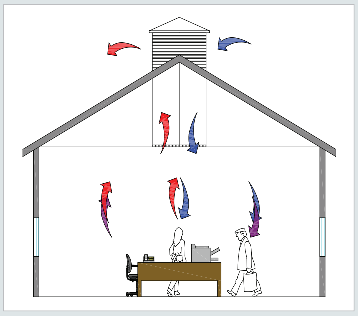
### ■ Crossflow

Air enters at low level and leaves through the opposite wall at a high level, usually driven by wind power. This can be as simple as opening two windows on opposite sides of the room, or by installing two wall-mounted units to allow controlled crossflow ventilation. It is suitable for any room, though as the air moves across the room there is an increase in temperature and concentration of pollutants, and so there is a limit to the width of room that can be cross-ventilated. CIBSE's guidance states that the maximum distance over which crossflow is effective is five times the floor-to-ceiling height. The cross-ventilation method is normally combined with a penthouse turret application to dispose of the stale air once it has left the room, using the stack effect.



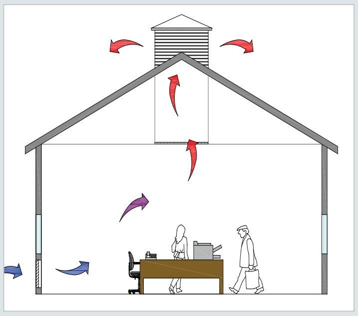
### ■ Downflow

In this scenario, air enters via a roof-mounted penthouse turret at a high level, and the stale air leaves the building via the same penthouse turret. This method is particularly effective in large, open spaces with high ceilings, such as warehouses, distribution centres, gymnasiums, sports halls, assembly areas and supermarkets. Within GDL natural ventilation split turrets, there is an internal split within the turret unit and duct extension sleeve, so the supply and extract air are kept separate, avoiding cross-contamination and short-circuiting.



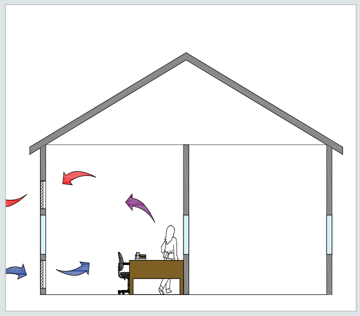
### ■ Stack effect

In this scenario, air is drawn in by either a window or wall unit and across the space, as described in the crossflow ventilation method. Stale air is then exhausted via a roof-mounted penthouse turret at a high level. The air flows across the width of the building. The system uses the buoyancy effect, where warmer, lighter air is displaced upwards when it meets cold, dense air. The design of the system will depend on the layout of the building.



### ■ Single-sided

This can be as simple as opening a window on one side of the room, which means the air enters and leaves via the same window. This works more effectively if internal doors are closed. As a general guide, airflow within a room will only work effectively where the width of the space is no more than approximately twice the floor-to-ceiling height. Wind turbulence is the main driving factor.



## COMPONENTS OF AN EFFICIENT NATURAL VENTILATION SYSTEM

Most natural ventilation wall-mounted units are generally made up of the following components: weather louvre, insulated damper, acoustic panel, heating coil, fascia grille. In a GDL system, the characteristics of each component is as follows.

■ Weather louvre – a quality, high-performance weather louvre is required to prevent rain from entering the building

■ Insulated damper – the insulated damper must be a tight shut-off damper, with a leakage rate of less than 2.5$m^3$/hr/$m^2$ at 50pa. It should have insulation quality equal to the window it replaces (approximately 1.6W/$m^2$K. The damper should be controlled by a modulating controller, which will give a better energy saving than positional or open/close models.

■ L-shaped heating coil – an L-shaped coil eliminates the "cold drop" effect, where incoming air in winter falls to the floor creating a blanket of cold air. This also allows better convection, so the coil can be used as a front-line heating system in winter when air is recirculating around the room.

Units are controlled by wireless $CO_2$ sensors and temperature sensors, and have a manual override. A single control system can control up to five units. Wireless controls are optional, but do offer cost savings over hardwiring.

## SOLAR-POWERED NATURAL VENTILATION

**Solar power is commonly used to assist in the effective operation of a natural ventilation system, powering the penthouse turret fan. This method is an energy efficient and cost-effective way to increase the ventilation rate throughout the building, rather than incorporating a costly mechanical arrangement. A solar photovoltaic cell is located on the roof of the turret itself. This powers a DC battery that runs a reversible fan, allowing 24-hour supply or extract ventilation. This can work in harmony with the wall unit or as a standalone product using the downflow effect, whereby fresh air circulates and stale air is extracted via the roof-mounted penthouse turrets. GDL's Solarstore solution allows increased ventilation in summer and at times of high occupancy, and also improves the effectiveness of night-time cooling.**

# QUESTIONS

Having read the CPD module, you should now be ready to answer the questions below. Please tick only one box per question.

**1. According to CIBSE, what is the recommended level of ventilation in occupied areas?**

- ☐ a. 8l/s/p
- ☐ b. 6l/s/p
- ☐ c. 4l/s/p
- ☐ d. 3l/s/p

**2. In which of the following environments would natural ventilation NOT be suitable?**

- ☐ a. Supermarkets
- ☐ b. Classrooms
- ☐ c. Operating theatres
- ☐ d. Sports halls

**3. Which of the following correctly describes what happens when warm air meets cold air in an enclosed space?**

- ☐ a. Cold air is less dense than warm air, so the lighter cool air rises and the warm air falls.
- ☐ b. Cold air is less dense than warm air, so the lighter warm air rises and the cool air falls.
- ☐ c. Warm air is less dense than cold air, so the lighter warm air rises and the cold air falls.
- ☐ d. The cold air remains at a high level.

**4. In which of the following types of airflow does air enter and leave a space through a roof-mounted penthouse turret?**

- ☐ a. Crossflow
- ☐ b. Downflow
- ☐ c. Stack effect
- ☐ d. Single-sided

**5. What is the maximum ratio of room width to floor-to-ceiling height for effective single-sided ventilation?**

- ☐ a. 5:1
- ☐ b. 4:1
- ☐ c. 3:1
- ☐ d. 2:1

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**BUILDING MODULE 5 DEADLINE**: Return your answers by 18 November 2011

To take this module, you can return the answers one of following ways:

- Complete the form online at **www.building.co.uk/cpd**
- Fax the form to 020-7560 4014
- Scan the form and email to **building.cpd@ubm.com**

If successfully completed, certificates will be distributed two weeks after the module closes.



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