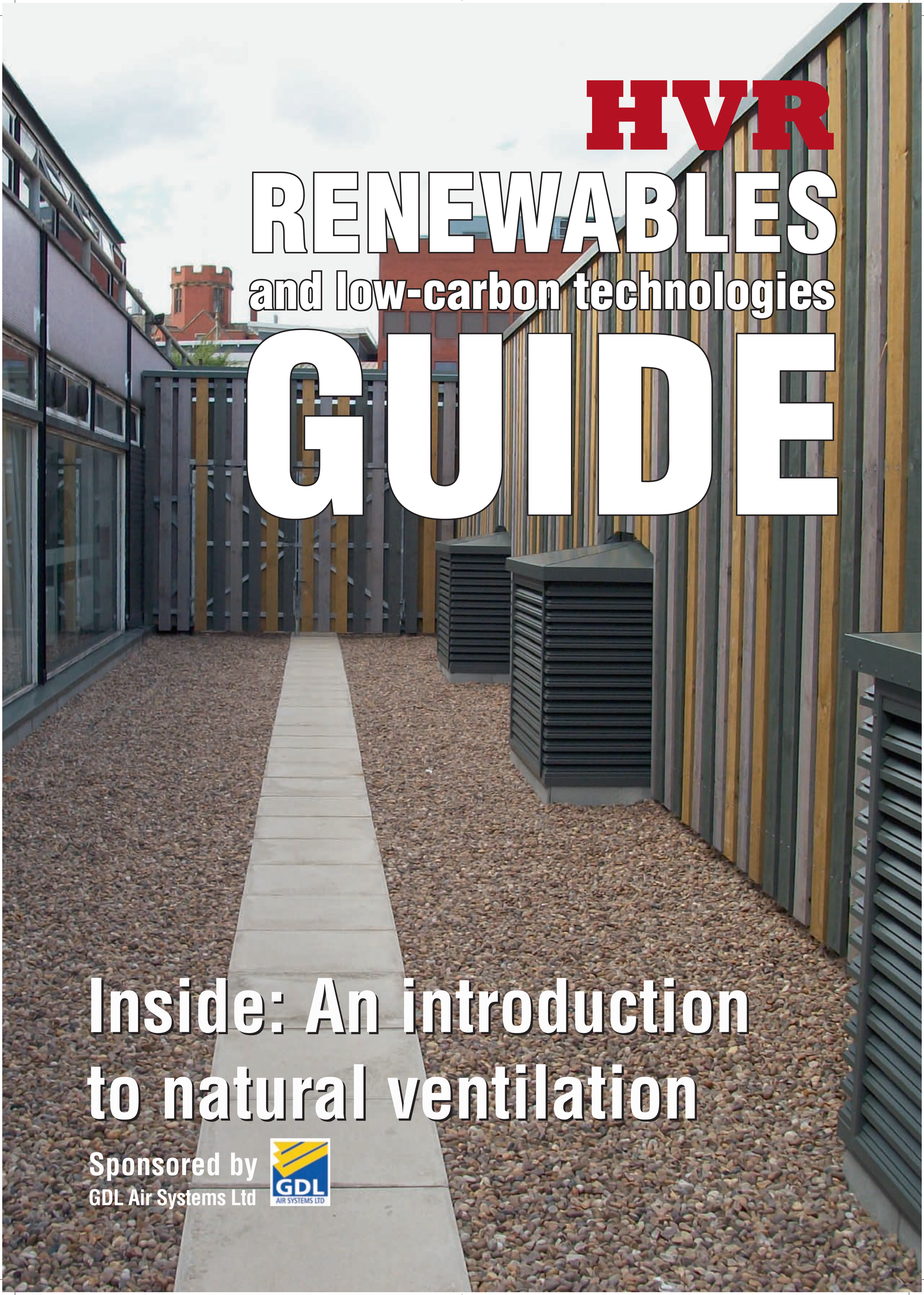

HVR RENEWABLES

and low-carbon technologies

GUIDE

Inside: An introduction to natural ventilation

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An introduction to natural ventilation

THE PURPOSE of ventilation throughout buildings is to provide good indoor air quality in both summer and winter and to prevent odours from seeping throughout internal spaces. To prevent pockets of stagnant air and reduce air temperature gains produced by humans, the Chartered Institution of Building Services Engineers (CIBSE) suggests that in all occupied areas, eight litres of fresh air should be provided per second per person (l/s/p). In all other areas, such as corridors and halls, 3l/s/p should be provided.

In summer, more than the recommended level may be necessary to remove unwanted heat gains produced by humans, solar and machine gains. In winter, lower ventilation rates are expected.

Carbon dioxide monitoring Carbon dioxide (CO_2) 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. 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, the 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.

Building 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 new or refurbished building's design and build.

Natural ventilation is particularly suitable for a school environment and has numerous sustainable, cost effective and health benefits. The Government initiative 'Building Schools for the Future' included reducing the carbon emissions by at least 60% compared to those constructed in 2002, Zero carbon schools by 2016 and a BREEAM rating of at least 'Very Good'.

Introducing 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 seasonally.

Ventilation demand changes 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.

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.

Sustainable 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.

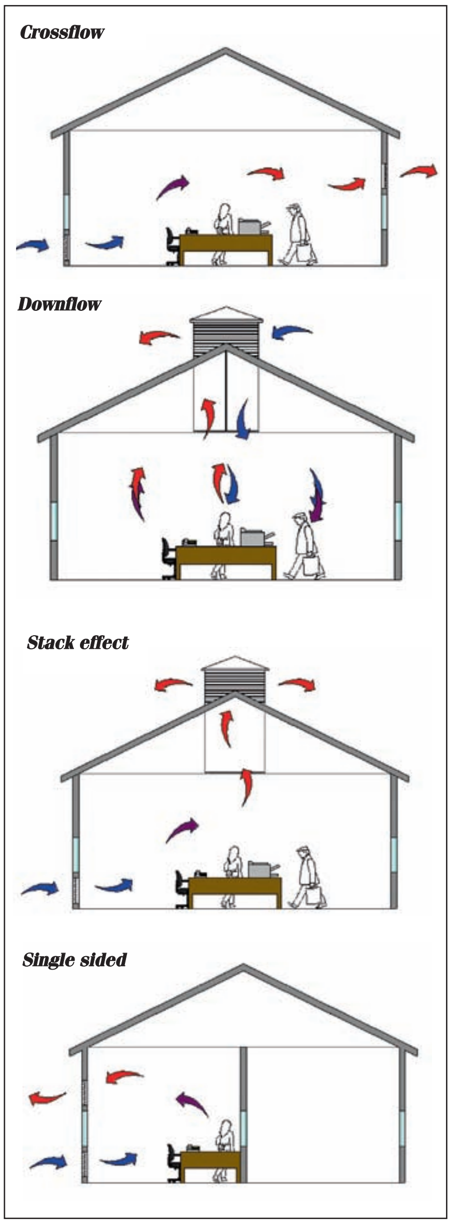
Health benefits A constant supply of cool fresh air eliminates "sick building syndrome", where in a mechanically ventilated building re-circulated air can cause occupants to become ill. A continuous supply of fresh air replacing stale air increases concentration levels. By replacing open windows, security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

Wind and buoyancy When designing and specifying 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.

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. These areas need to be mechanically ventilated and cooled to dispose of the excess fumes. Operating theatres also need to be mechanically ventilated as they need to be constantly pressurised so the outside air does not bring in 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.

Natural ventilation systems use different types of airflow:



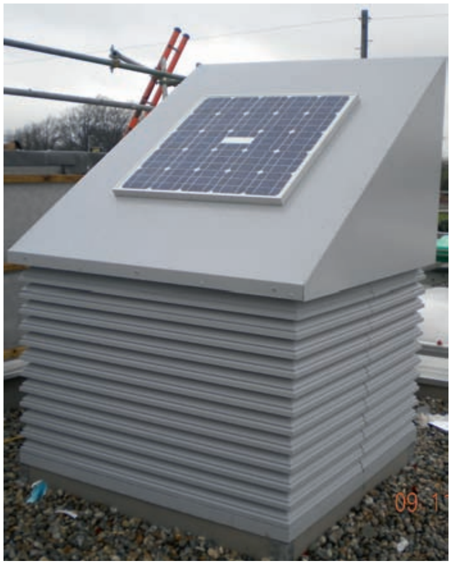
Morrison's Bridgewater Solarstore turret

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.

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.

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. Cross-ventilation is normally combined with a penthouse turret application to dispose of the stale air once it has left the room, using the stack effect.

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 system design will depend on the building's layout.



Downside Solarstore turret

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

- Weather louvre – a 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 2.5m^3/hr/m^2 at 50pa. It should have insulation quality equal to the window it replaces (approximately 1.6W/m2K). 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 re-circulating around the room.
- Controls – 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. When implementing a downflow or stack effect scenario, a penthouse turrets are installed at roof level.
- Penthouse Turrets – Natural ventilation split turrets are designed to offer a balanced supply of fresh air whilst also having the ability to remove warm stale air. The supply and extract air are kept separate to avoid cross contamination.

Solar-powered natural ventilation – Solar power is commonly used in natural ventilation systems powering the Penthouse Turret fan. Energy efficient and cost-effective, it increases the ventilation rate throughout the building rather than incorporating a costly mechanical arrangement. A solar photovoltaic cell is located on the roof of the penthouse turret itself. powering a DC battery that runs a reversible fan, allowing 24-hour supply or extract ventilation.

Solarpipes – The GDL Solarpipe is the latest development within GDL's Intelivent natural ventilation range. The system diffuses natural light into the building eliminating the need for artificial lighting. Natural light enters the turret at roof level and is directed into the building via reflective tubing where the light is dispersed into the required areas.

For more information visit www.grille.co.uk

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