Sustainable Building Design

Zero Carbon Evolution

ZERO CARBON EMISSIONS

Pure and Hybrid Natural Ventilation

GILBERTS

Pure and Hybrid Natural Ventilation

With climate change an established and worrying fact the world is now rushing to meet a target of Net Carbon Zero. Effectively we reach net zero when the amount of carbon dioxide that we add is no more than the amount taken away. This is not only a legal target for 2050, as set out by the Paris agreement, but also a great aspirational goal that is being adopted by responsible businesses all across the globe

Over the next 3 decades what we do to get to net zero will have a major impact on the world we live in.

Together it is believed that building and construction are responsible for 39% of all carbon emissions in the world, with operational emissions (from energy used to heat, cool and light buildings) accounting for 28%. Reducing energy consumption in buildings has therefore become a key target.

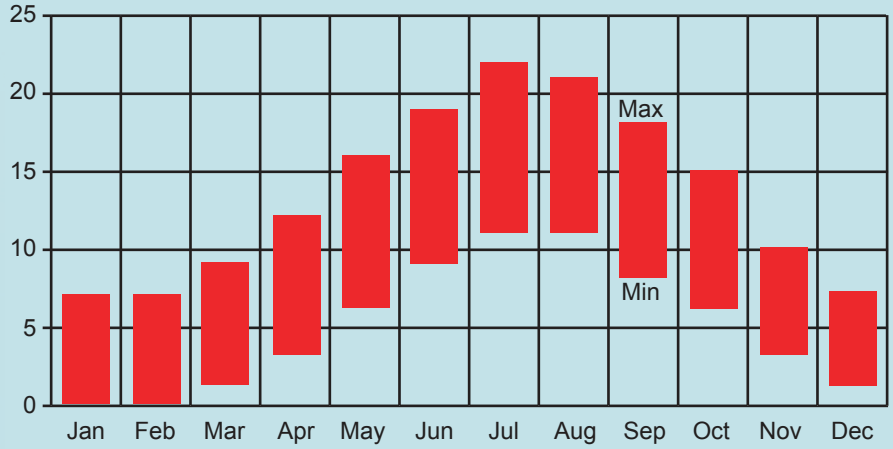
Whilst recognising this we also understand the contrasting need to provide a natural healthy indoor environment. With air conditioning a key energy consumer in buildings moving away from mechanical driven systems is an understandable and admirable goal. The DFE recognise that natural ventilation has a key role to play in meeting future energy goals in schools combining, as it does, little or no energy consumption with a clean, comfortable and healthy working and learning environment.

The Practicalities: Weather Profile

If we want to move away from energy driven systems perhaps, unexpectedly the great British climate works to our advantage. With a mild maritime climate warmed by the gulf stream Britain experiences cool, wet winters and warm, wet summers. It rarely features the extremes of heat or cold that may be common in other climates.

This limited variation in extremes serves a beneficial purpose enabling us to reduce our need and dependence for cooling and ventilation on mechanical solutions.

London Temperatures (degress C)
Average Daily Maximum & Minimum by Month



Solutions

Pure and Hybrid Natural Ventilation

Natural ventilation, unlike mechanical fan forced ventilation, simply uses the naturally occurring pressure differential forces of air movement, wind and buoyancy to deliver a steady supply of fresh air for building ventilation and space cooling. In an environment where energy conservation is at a premium this sounds like an ideal solution…..and so it is!

Naturally ventilating a building actually offers the best of both worlds combining little or no energy consumption with low capital costs, whilst still providing adequate fresh air and comfort temperature conditions throughout the year.

With plant room also eliminated, services space minimised and lower servicing/maintenance costs Natural Ventilation now makes for one the most practical choices of the day.

Modern buildings with their low u values and high heat gains typically have a high cooling requirement.

The climate in the UK and many parts of central through Northern Europe is perfectly suited for Natural Ventilation applications with low extremes of temperature providing an ample supply of fresh cooling air even in a typical summer.

With zero carbon both an achievable and sustainable goal responsible design strategies include natural ventilation as an important design consideration. Gilberts expertise with the help of thermal modelling can help determine if your building can meet this carbon neutral goal.

Pure Natural Ventilation

Pure natural ventilation strategies are founded on two basic operational strategies and essentially comprise of either of wind driven systems or a buoyancy (stack effect) system.

Wind Driven

In some locations and building designs wind alone can be used as the principal driving force.

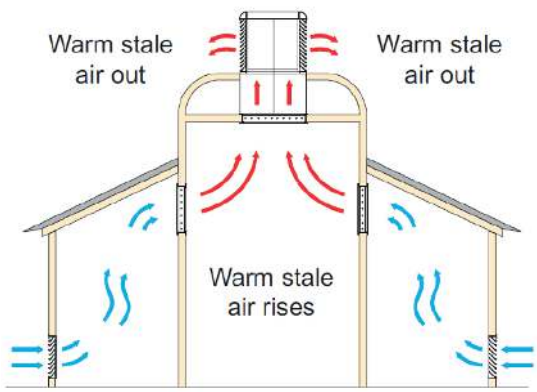
In wind driven systems the air on the wind ward side of the building creates a positive pressure with corresponding negative pressure generated on the leeward side. Using this effect air can be easily drawn through the building. Although wind driven systems can be effective, building design, orientation and location factors are important here for a successful result.

Stack Effect

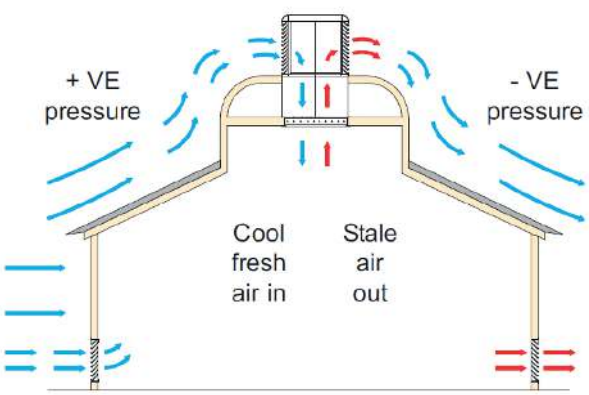
Although helpful, Natural ventilation systems do not need wind to operate satisfactorily. More effective strategies employ alternative buoyancy and stack effects instead to provide the ventilation base. Instead of wind pressure a vertical stack or shaft in the building can be utilised to allow warmer air to migrate and rise through the building to high level outlets whilst drawing fresh cool air in from low level. Stack ventilation does not rely on the wind at all and, because it does not rely on the pressure or direction of the wind either, offers greater reliability as well as more flexibility on the placement and location of the air intakes.

Natural Ventilation Strategies

Stack Driven



Wind Driven



Hybrid Natural Ventilation

In recent years there has been a new evolution on the natural ventilation design theme. Instead of pure natural ventilation new “hybrid” solution have been developed with the intent of capturing the best of both natural and forced ventilation systems

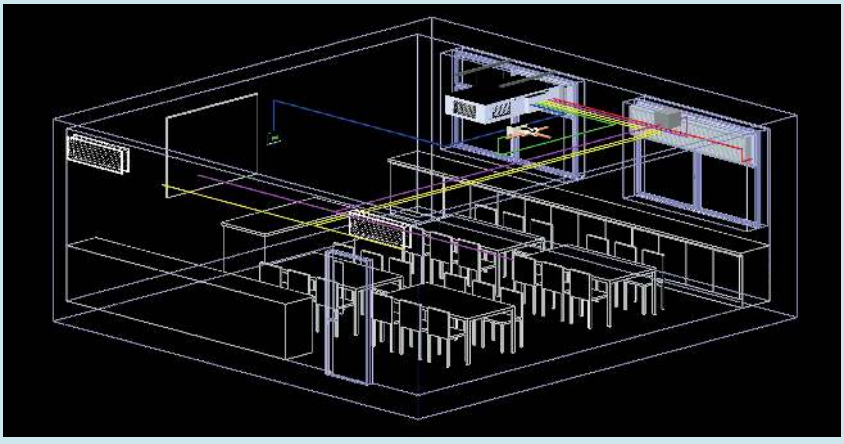
Unlike a normal full natural ventilation solution dynamic hybrid scheme offer single sided terminals that include an ultra low power fan assistance feature able to energise in poor air movement conditions to ensure adequate ventilation at all times. Whilst fan power assistance may seem at odds with a low energy ventilation concept it is important to point out that the fan is there to provide only occasional support ensuring that the terminal operates at all times to provide design heat recovery and ventilation requirements. And it is truly energy efficient. With a design consumption of just 34kw per year per classroom Mistrale MFS costs less than £5* per classroom per year yet guarantees full operational ventilation and cooling efficiency at all times.

Unlike other designs, Mistrale MFS is a stand alone system providing adequate ventilation and cooling without the need for supportive systems such as opening windows although it can still be integrated with other heating, cooling or ventilation strategy if required.

**Based upon energy cost of £0.12 per kw/h.*

Incorporating an ultra low power fan our new Mistrale MFS is not in the strictest sense a full natural ventilation solution. One of the latest innovations in ventilation our new design “Fusion” terminal is able to provide an extremely low cost ventilation solution with the added benefits of heat recovery.

The terminal uses natural air buoyancy with low power fan assistance to deliver a steady supply of fresh air from a single wall/ window façade whilst allowing it to blend controlled amounts of mixed extract air for heat recovery. The concept is simple and was driven by the need to enhance our natural ventilation solutions to include a unit situated in just a single wall or façade but able to control the internal room space accurately all year round irrespective of weather, wind or temperature conditions and with the added benefit of using previously discarded warm air for heat recovery without a heat exchanger.



For over 60 years Gilberts have been a driving force in air distribution and since 2006 a trend setter in natural ventilation solutions. Successive market leading solutions that combine practical design features with industry leading specifications

Key Product Summary

Mistrale 75

A traditional passive natural ventilation inlet specifically designed to fit in to both walls and windows. A typical Mistrale 75 cassette comprises of an “Class A “ 50 or 75mm pitch external weather proof louvre and a low leakage, insulated air volume damper to control the air movement and sealed to $3m^3/Hr/m^2$ at 50 Pa

Mistrale Fusion

One of the latest innovations in ventilation our “Fusion” terminal is able to provide an extremely low cost hybrid natural ventilation solution with the added benefits of heat recovery. Unlike a normal full natural ventilation solution MFS is a dynamic hybrid that includes an ultra low power fan assistance feature able to energise in poor air movement conditions to ensure adequate ventilation at all times.

Roof Turrets

designed to suit wind driven systems or stack effect solutions with internal partitions and dampers providing for full and accurate air control. High weather efficiency design as standard to eliminate weather ingress and units can be fitted on to both flat and pitched roofs. Design styles are flexible with traditional square designs most popular and with a variety of roof top options. Special or bespoke roof tops can also be included to complement or contrast with your building design.

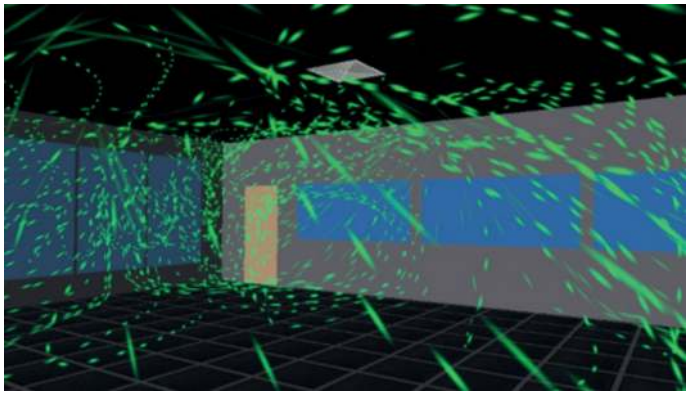
Mistrale MFS-V

Provides a roof top hybrid natural ventilation solution. Perfect for internal zones such as auditoriums or other areas where sidewall solutions may be problematic such as sports halls.

A penthouse turret on the roof builds onto a vertical sleeve which terminates with an air distribution plenum inside the space. The terminal uses natural air buoyancy with low power fan assistance to deliver a steady supply of fresh air from whilst allowing it to blend controlled amounts of mixed extract air for heat recovery

Making sure it all works

When developing a natural ventilation solution we really need to make sure that we get the performance results as we intended. We need confidence that your solution performs to the design parameters and that all of the necessary comfort conditions are met.
For verification there are two Primary tools we can use



Computational Fluid Dynamcis (CFD)

Gilberts, in collaboration with software manufacturer Solidworks Flow Simulation, have been developing their CFD expertise and technology to bring about a new dimension to natural ventilation selection.

Based on the Computational Fluid Dynamics techniques the software, using a 3D CAD base, allows the our engineers to generate a computer graphical model of any building or area complete with air terminal, or other, devices. The model can then be populated with sub structures, fixtures, fittings and any other heating/cooling loads enabling the software to accurately map and predict both the airflow and heat transfer behaviour in three dimensions.

With the models built, the software can be run and the air movement scenario examined. Although the calculations are obviously important a further key bonus is that these wire frame constructions and the solved data can then used by the software to generate animated models which provide a realistic environment for us to view the results in. As well as being a good visualisation tool these models also provide engineers with added value features such as.

1. Temperature/Velocity contour plots which can be moved through each axis within a model to show temperatures and velocities. Pinpoint readings can also be taken anywhere on these plots.
2. Vector Plots. These can also be moved through each axis highlighting any troublesome areas.
3. Surface plots to terminal velocities. This function allows penetration into occupied, or other, zones to be highlighted at any desired velocity.
4. Particle distribution video clips can be created in popular PC movie formats, which give us a clear visual indication of the air distribution patterns within the model.

Using this software complex applications and ideas can be proven without the need for laboratory testing. Even where testing may be necessary such as for a modified or non standard diffuser, the air movement lab can be used to confirm the accuracy of the simulation and the software used for future applications, saving both time and cost.

Thermal Modelling

Natural ventilation schemes are typically complex and in order to ensure that the right levels of ventilation and air quality are delivered it is often beneficial to develop a thermal model for the application. Our chosen software to analyse the building, along with the performance of the ventilation & airflow systems, is Integrated Environmental Solutions Virtual Environment or IES (VE).

IES is recognised as an Industry Standard suite of software for thermal and energy analysis of buildings, it is accredited by DCLG to perform regulatory compliance calculations as well as providing dynamic simulations in accordance with CIBSE AM11.

By using software common to the Building Services Industry, rather than internally developed programmes, we are able to seamlessly integrate with the design and design teams for each and every project.

We are able to either develop a model and apply our systems to it or equally we can take a third party model and advise upon improvements or changes which could be made by accommodating our system which would either be cost neutral or cost beneficial to the scheme overall.

Needless to say, all calculations have been undertaken by accredited energy assessors with many years experience in the analysis and reporting of building performance by simulation.

Gilberts have partnered with Zero Energy Design Ltd for the provision of modelling and analysis for our Mistrale system. ZED are a specialist Building Physics and Sustainability consultancy with a focus on the Education Sector.

With this benefit we are able to develop our products alongside the practical experience gained over many projects, over many years, back to the days when ‘ventilation strategy’ meant opening a window in all weathers.

We recognise that there are so many measures and considerations which go into constructing a successful school and as providers of the main environmental treatment system, we’re aware that our contribution is more than many. Our wish however is to ensure the systems we develop make beneficial contributions towards Part L Compliance & BREEAM scores, likewise we wish to ensure that the specification of our system does not inhibit design decisions elsewhere.

This is why we have taken a holistic view of building performance when validating our system.

Hybrid Control strategy

Normal Mode

Normal mode would be during typical winter, autumn or mild weather conditions with temperatures ranging between -5 and +20°C. In these instances standard room heating (radiators etc) would be employed to bring the room up to temperature (around 20˚C)

As the room becomes occupied we can expect the heat load to increase and room temperature to rise. At a given set point (typically 22˚C) the terminals will come on line and open the fresh air inlet damper allowing cool air to permeate into the room space. The fan is also energised to assist with air distribution ensuring that 2 MFS/128 units can deliver the full provision of 256 litres/sec of fresh air (8 l/sec for a 32 person classroom). The fan provides the correct air velocity to avoid dumping and to ensure an even distribution of airflow throughout the space.

Whilst fresh air provision must be maintained for comfort conditions we also need to be careful to avoid any differentials between the room and cooling air. To ensure the fresh inlet air stays within these parameters the terminal includes temperature sensors that control a mixing damper which modulates to allow warm exhaust air to be re-circulated. By doing so the terminal can temper the cool air to ensure a maximum temperature differential of 10˚C.

The room temperature and ventilation will continue to be controlled automatically within the set point criteria for the room. The terminal includes a CO2 sensor as well as room temperature sensor and can vary fresh air inlet and recirculation to ensure that maximum CO2 levels are not breached.

When heat loads are removed, such as during breaks or lunch, the room will be balanced to a neutral status and the unit will go into standby. Fresh air dampers will be closed and the fan switched off. The terminal will remain in standby until either temperature or CO2 levels exceed their set points

Summer mode

Outside of normal hours of operation when the set point for the room exceeds 20 degrees the damper will fully open and the fan will cycle providing 100% fresh air cooling for warm air evacuation.

Once room temperature drops below set point (typically 20˚C) the fan shuts down and cooling air will be drawn in naturally until room temperature hits the minimum room set back (typically 16˚C. The fan will provide additional boost if outside temperatures do not fall sufficiently for natural cooling. Once the room temperature is achieved the damper will close and seal the building.

Night Cooling mode

Outside of normal hours of operation when the set point for the room exceeds 20 degrees the damper will fully open and the fan will cycle providing 100% fresh air cooling for warm air evacuation.

Once room temperature drops below set point (typically 20˚C) the fan shuts down and cooling air will be drawn in naturally until room temperature hits the minimum room set back (typically 15˚C) The fan will provide additional boost if outside temperatures do not fall sufficiently for natural cooling. Once the room temperature is achieved the damper will close and seal the building.

ZERO CARBON EMISSIONS

Natural ventilation can be a key weapon in our worldwide drive to Net Zero.
Here at Gilberts we have the expertise and the solutions to help us meet these goals

For guidance, advice, technical assistance or more information on our range of solutions
please go to our website **www.gilbertsblackpool.com**

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