

# Natural Ventilation



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## - A benefit for the environment, architecture and economics

An estimated 40% of all energy in Western Europe is consumed by buildings. As energy generation is primarily coal based, this creates high levels of CO<sub>2</sub> emissions.

Thankfully up to 84% of a building's energy consumption could be under the control of its Building Energy Management System - BEMS, this includes intelligent window control.

### ...environment

It is important to focus on indoor climate solutions that do not consume more electricity, avoiding the production of more CO<sub>2</sub> than is necessary. An indoor climate solution with Natural Ventilation uses nature's own forces, thermal buoyancy and wind pressure on buildings, and is therefore a more sustainable solution than other more mechanical solutions.

### ...architecture

A traditional mechanical ventilation system typically occupies 4-7% of the building floor area and 15% of the building height. The best solution for Natural Ventilation is achieved when the requirement for fresh air and natural light is planned for in the early design stages. Choosing an indoor climate solution with Natural Ventilation provides the architect with design freedom.

### ...economy

Systems based on Natural Ventilation generally have a lower capital cost as well as substantially lower operating costs than comparable mechanical solutions.



### Health & Productivity

In Western Europe we spend up to 90% of our time indoors, and up to 30% of the building mass does not contribute to a healthy indoor climate. We breathe an average of 12.000 litres of air per day, so the quality of air in the rooms we occupy has significant importance.

An indoor climate solution with Natural Ventilation enables fresh air to enter through the facade or roof windows.

### User satisfaction

Many studies show that satisfaction with the indoor climate is greater in buildings with Natural Ventilation than in other traditional indoor climate solutions. User satisfaction is also high because the user has the ability to influence how much air is coming in - simply by opening or closing the windows with a keypad.

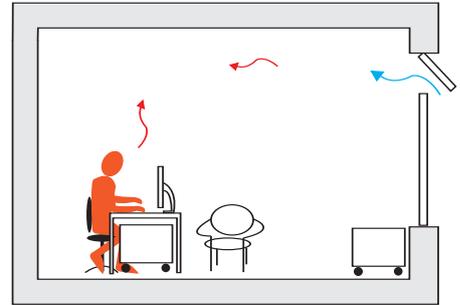
# Ventilation principles

The driving forces in Natural Ventilation are thermal buoyancy and wind pressure on buildings. The design of the building, the form of the window openings and location have a significant impact on the quality of the indoor climate.

Basic principles:

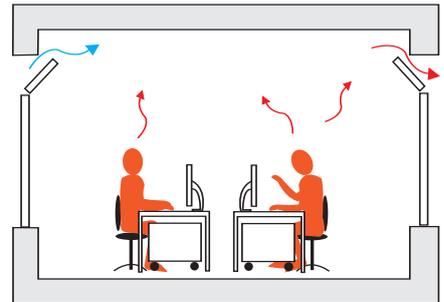
## Single-sided ventilation - Figure 1

The windows can only be opened on one side of the room. The amount of fresh air coming into the room is limited by single-sided ventilation. It is recommended that the depth of the room should not exceed 2.5 times the clear height of the room and that the space is not used for meeting rooms, classrooms or similar.



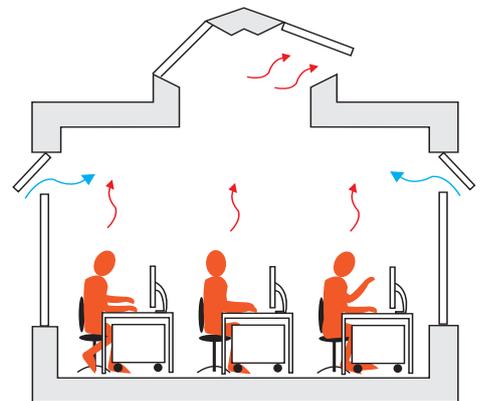
## Cross-ventilation - Figure 2

Windows in two or more facades can create cross-ventilation of the room. The ventilation is powered primarily by the wind, which creates differences in wind pressure on the facades in which the window openings are located. As a principle rule cross-ventilation can be used effectively when the depth of the room is up to 5 times the clear height of the room.



## Stack-ventilation - Figure 3

Stack-ventilation occurs when there is a height difference between windows – i.e. between facade and roof windows. This type of ventilation is primarily driven by warm air rising to the top creating a pressure difference which drives the ventilation. The best effect is obtained when the openings for Natural Ventilation are placed so that the wind pressure contributes to an increase in the driving pressure.



## Hybrid ventilation

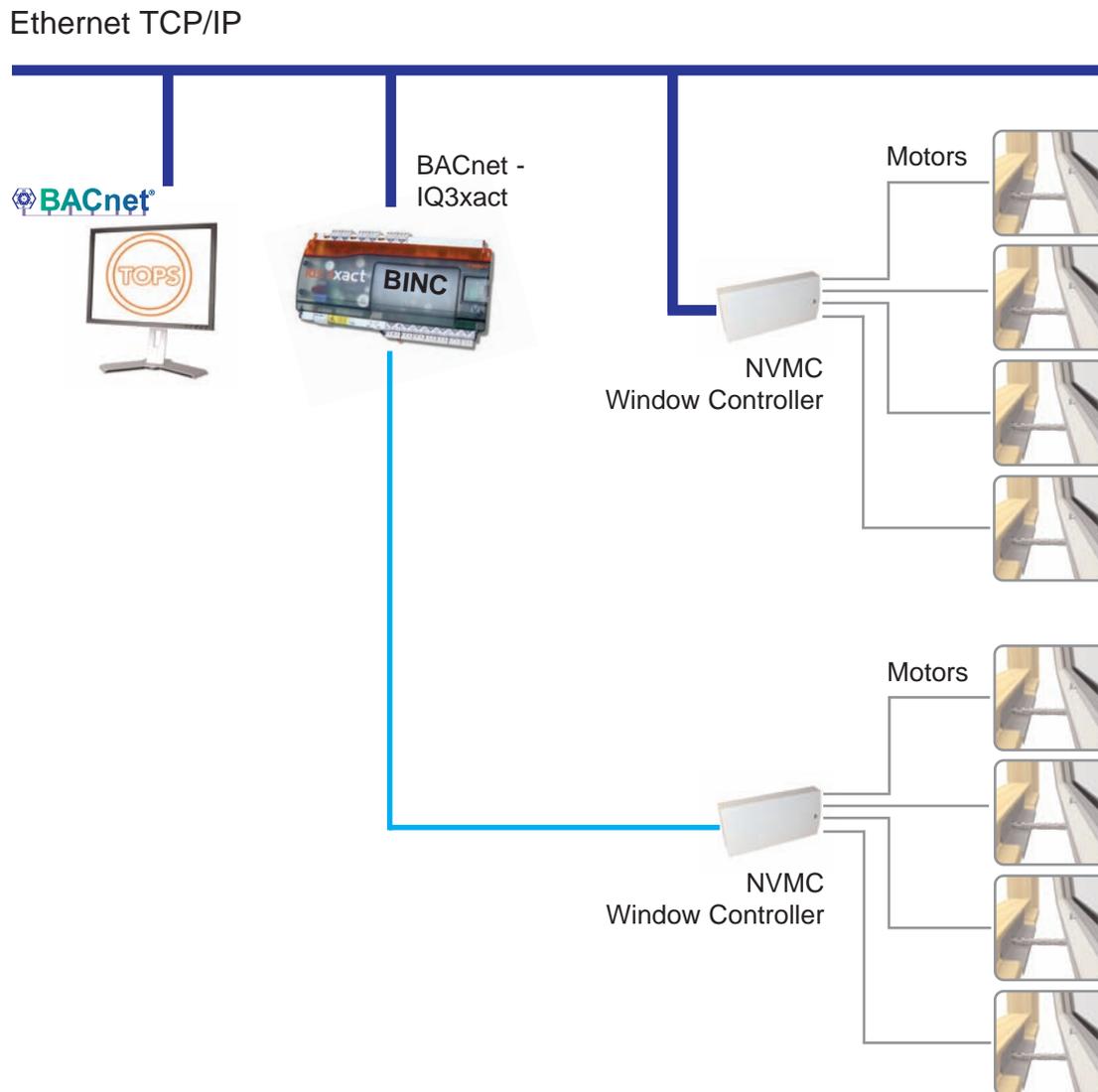
In a number of projects you may choose to install a hybrid ventilation solution that exploits the advantages of Natural Ventilation and support these with mechanical ventilation.

*There are two types of hybrid ventilation:*

1. Natural Ventilation supplemented by mechanical ventilation, to ensure good ventilation in very deep rooms.
2. Natural Ventilation supplemented by mechanical ventilation, where the mechanical ventilation is used in the very cold periods when there is a need for heat recovery.

The choice of hybrid ventilation depends on the requirements of the specific project.

# System Architecture



Using MotorLink™ technology, Trends Building Energy Management System - BEMS, now offers direct intelligent control of each window actuator. MotorLink™ technology provides the following benefits:

- Accurate positioning for optimal climate control
- No noise distractions making it ideal for office/classroom environments
- The reversing function limits entrapment and prolongs life of window gaskets
- Genuine synchronisation ensures all windows operate together

### Intelligent controls of window actuators

The demand for automated and intelligent facades has grown dramatically over recent years and this development will continue while the focus is on energy consumption and sustainability. Automated windows and roof vents can provide buildings with the benefit of improved indoor climates through Natural Ventilation.

The demand for greater and more intelligent control over these automated windows is increasing, with two way communication from the actuator for actual position feedback and two speed operation adding significant benefits.

### Position control and feedback

The advanced control solutions can provide millimetre-by-millimetre control of the actuators. Accurate positioning of windows is necessary to obtain an optimal indoor climate during all seasons and all weather conditions. Research studies have shown that even a minor change in the window position will have significant influence on the indoor climate – especially on windy days.

Data communication between the actuators and the Motor Controllers enables the actuators to report back their precise opening/closing position. This enables the BEMS system to know the exact position of the vents at all times.

Knowledge of the exact position of the windows enables the Trend BEMS system to accurately position the windows to ensure that they are open to the same amount which maintains the external appearance of the facade. This negates the need for the BEMS system to close the windows at numerous times during the day in order to reset their position, preventing so called “hunting” of actuators is also a benefit of this feature.

### Two speed operation

The Trend actuators equipped with the special MotorLink™ technology enable different opening/closing speeds to be used, dependent upon the digital command received. For instance a slow and soundless speed when in automatic mode and a faster more audible speed when activated by the manual keypads in order to provide an immediate visual response to the user. This technology makes it possible to operate automatically (slow speed and soundless) without disturbing lessons in schools or meetings etc.

### Genuine synchronisation

The MotorLink™ actuators can run fully synchronised – without an external synchronisation module. Up to four actuators can work together on one window with a tolerance of less than 2mm. Through a patented solution the actuators communicate with each other directly and adjust their speed so that they are always operating together. This real time synchronisation is the best guarantee that the window is not damaged by actuators running at different speeds.

### Reversing function

The WindowMaster actuators include an integrated reversing function, which enables the pressure on the window gaskets to be released by a few millimetres after the windows have been closed. This ensures a prolonged life span of the gaskets and air tightness of the window. The reverse function ensures that the window gaskets are not destroyed by the closing force of the actuator.

### Pressure safety function

Window actuators equipped with the special MotorLink™ technology can reduce the risk of entrapment. The actuators can be programmed to stop and reverse if they encounter obstacles when closing. The setpoints determining when the actuators are to reverse are adjustable, but there is a limit to how sensitive they can be set as they still need to overcome the forces required to close and seal the window.

### Fault indication

Actuators from Trend using the special MotorLink™ technology include a two-way communication between the Motor Controller and the individual window actuator. Feedback from every window actuator can provide an early indication of any potential faults. This feature makes it very easy for the Building Manager to locate any fault in the system.

## Legislation

The legal requirements for indoor climate in buildings appear in the current building regulations.

The Chartered Institution of Building Services Engineers also publish guidance in Application Manual 10 (AM10) titled 'Natural Ventilation in Non-Domestic Buildings'.

# Recommendations for design with Natural Ventilation

It is important that the automatically controlled windows are placed as high as possible within the space.

Experience shows that it is also important for users to be able to control the windows (by overriding the automatic control), when greater or lesser opening of the windows is desired.

In buildings with Natural Ventilation the height of the room should be at least 2.7m and preferably slightly higher for the best indoor climate.

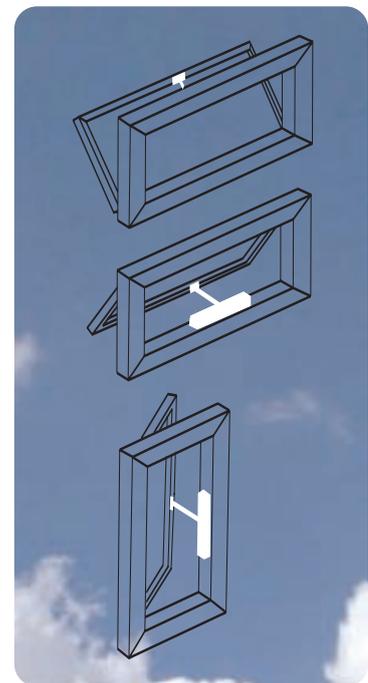
The automatic windows should ideally be top-hung outward opening or bottom-hung inward opening and have a height of 400-500mm.

Windowtype:

Bottom-hung inward / outward opening

Top-hung outward opening

Side-hung inward / outward opening



**International research results show that a good indoor climate is crucial for human well-being, productivity and learning.**

**Research has shown that an increase in productivity of up to 15% can be achieved with a good indoor climate.**

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