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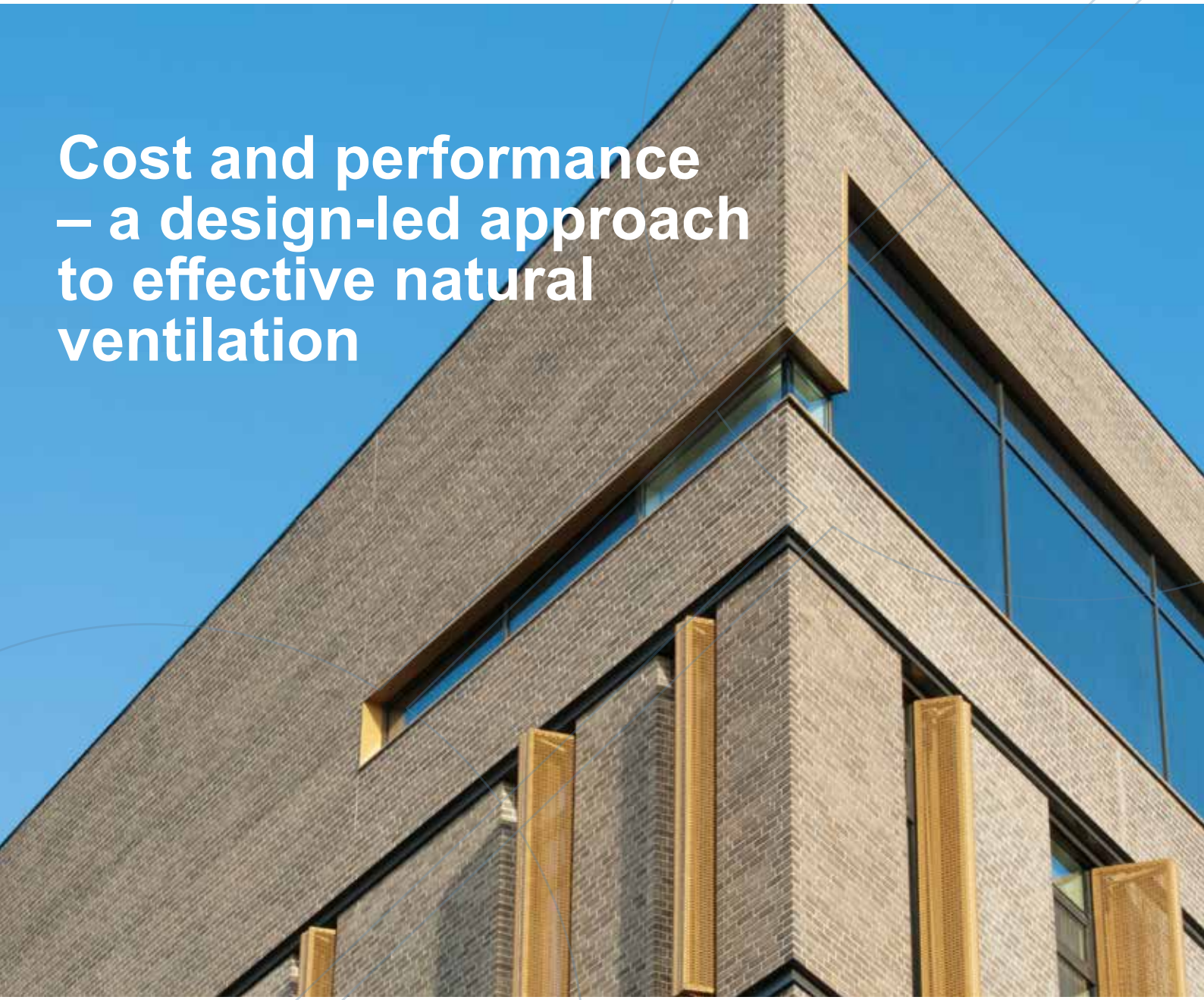
Cost and performance – a design-led approach to effective natural ventilation



Natural ventilation solutions have been under the microscope recently in terms of energy performance and user satisfaction. WindowMaster's Tom Lymn examines the issues and clears up some misconceptions

There are several key issues facing natural ventilation which tend to concentrate around compliance, cost and energy performance. The benefits of natural ventilation are clear and include lower capital and operating costs, easily manageable control systems, reduced environmental impact and the improved productivity of the building's occupants.

However, there are some perceived problems relating to the performance of natural ventilation. Some recent post-occupancy studies have brought to light concerns over air quality, draughts, over-heating in the summer and higher than expected energy consumption.

Misconception

There is a widely held misconception that natural ventilation is not an adequate method of providing sufficient indoor air quality in buildings. The atmosphere is thought to be too hot, too cold or too stuffy. It is also said to create high energy bills and to give unpredictable results.

These issues can often be solved by improving the operation of control systems and creating enhanced understanding and delivery of natural ventilation strategies. They can be addressed successfully by paying close attention to design issues on such things as cross, side and passive stack air flow paths. The effects of airflow into a building must be measured, understood and integrated into any natural ventilation design.

Performance

Currently, performance specifications tend to be based around specific products and not on the building itself, its location or specific client needs. Designers need to take an holistic approach. Effective natural ventilation solutions must be aligned to these factors in order to deliver on performance.

Post occupancy

Post occupancy studies have found that some naturally ventilated Building Schools for the Future (BSF) projects are using considerably more energy than expected. There are also perceived issues around acoustics, health and security. This is because designs can, in some cases, be under-specified or 'value engineered'.

An article in Building Magazine (July 2011, pages 38-43) highlighted these issues, citing two high-profile examples of buildings that did not perform as they should have. The data used to illustrate the article was based on post occupation. However, it is important not to take the findings out of context. Careful design and planned commissioning would have avoided such things as over-stretching the natural ventilation

strategy and, more importantly, would have avoided running the mechanical heating and cooling systems in tandem all year round. An effective low-energy strategy requires efficient and integrated control systems.

Value engineering often introduces poor performance by reducing the effectiveness of the ventilation strategy as a whole. Sometimes elements of a scheme can be omitted in order to reduce the price of a contract. Further value-engineering critical elements without passing on additional financial savings to the client will affect performance for the end user.

Furthermore, trying to effectively use the building management system (BMS) to control third party window actuators is not straightforward and is unlikely to provide a fully effective solution. It can result in added complexity in addition to increased and hidden installation costs. It can also lead to conflict over who is responsible for resolving any issues that may arise. The answer is to seek an integrated and proven solution from a single supplier.

The focus for good design should be on providing a good indoor climate, as well as on energy consumption and sustainability. Natural ventilation must form part of the design of a building's integrated building energy management system (BEMS). The system needs to integrate fully with the BEMS and offer precise control. Using a BEMS to control automated facades throws up a number of challenges with regard to integration into the overall management system. MotorLink®, a state of the art digital data communication technology that provides improved control and functionality where automated windows and natural ventilation are part of a BEMS, solves many of these challenges.

Using a fieldbus to connect components results in reduced cabling and reduces point to point wiring and installation costs. It can be easily integrated into the natural ventilation control system or BEMS to provide improved control and functionality of the automated windows and natural ventilation part of the system.

"Value engineering often introduces poor performance."

Robust automated solutions can deliver the highest level of performance. Take-up can be achieved through emphasising to builders and end-users the benefits of accurate control, pre-emptive ventilation and effective night cooling. Sometimes, builders can be reluctant to take ownership of building performance. It is perhaps easier to put the onus on the client once the building has been handed over, particularly in the case of manual windows and associated rudimentary traffic light indicators. To avoid these scenarios there should be better guidance within the Part L of the new building regulations relating to solutions. For example, the potential for the poor performance of manual windows could be contrasted with the features and benefits of 'well controlled' automated solutions, which minimise energy and enhance the indoor

environment, with reference to accurate control, feedback and single source supply.

Historically, natural ventilation in buildings has not been well understood and has therefore been poorly implemented. This has fostered a reluctance to use effective, well-controlled natural ventilation solutions. Anything that fits into the 'natural ventilation' category can often be precluded from the design of the building as a result. This often leads to the use of more expensive over-engineered solutions that do not outperform natural ventilation solutions. They also add a cost premium to the project at a time when we should be looking at cutting rather than increasing the costs of construction.

Improving the understanding of natural ventilation is fundamental to increasing the uptake of sustainable solutions. As a result of poor historic experiences with weaker or poorly implemented solutions, effective alternatives are being overlooked. In this instance poor performance is accepted as inevitable. A knowledge gap can lead to over-engineered solutions being used – resulting in increased and often prohibitive costs.

Involving proprietary specialist solutions providers early in the design process can help. Automated windows – providing they are correctly considered and designed with the support of a specialist research-based solutions provider – can offer the most flexible solution to natural ventilation. A high-performance natural ventilation solution should offer a better return on investment in terms of indoor climate quality and energy savings during the life of the building when compared with manual windows or under/over engineered solutions. It High performance window automation – and therefore, climate and energy performance – is not a simple task. BEMS control needs the capability to deliver accurate control against a broad range of output options for each and every bank of windows around the building.

Natural ventilation

Natural ventilation can often also be used in a mixed-mode scenario to enhance building performance. Effective and proven automated natural ventilation will enhance the indoor climate, comfort and environment of a building. It will also considerably stretch the time that the building sits within pre-agreed limits, thus minimising or precluding the need for supplementary mechanical ventilation. In these instances natural ventilation should not be treated in isolation from the rest of the building services.

Controllability

Mechanical ventilation is perceived to have some advantages compared with natural ventilation in relation to cooling, draught minimisation, the ability to remove or prevent the ingress of odours and pollutants, insulation against external noise and central controllability. However, installation, running and maintenance costs are higher for mechanical ventilation than for natural ventilation. Also, independent studies have shown that the indoor air quality can be greatly reduced in these mechanical systems.

“Precise control within the first five centimetres of window opening is crucial to the control of temperature, carbon dioxide and noise.”

Accurate and effective window opening and closing must take into account factors other than external climatic conditions and room air quality. It must also be coordinated with the control of the building’s heating, any air conditioning and supplementary mechanical ventilation. Without this, occupant comfort may suffer and energy consumption can be unnecessarily high.

It is possible, with further and continuing improvement of natural ventilation system concepts, components, controls and design tools, to encourage the wider uptake of natural ventilation in office buildings. This is particularly true where natural ventilation on its own is sufficient to obtain comfortable indoor climate and good air quality with high user satisfaction and low energy consumption, installation and maintenance costs.

Effective natural ventilation depends on the ability to open and close windows as necessary to ensure sufficient air changes to maintain the optimum indoor climate quality. Millimetre by millimetre control of façade and roof windows is essential so that they automatically open and close according to the desired room temperature and CO_2 levels, as well as external temperature, rain and wind speed and direction.

Precise control
Precise control within the first five centimetres of window opening is crucial to the control of temperature, carbon dioxide, noise, draught reduction and security.

To deliver adequate natural ventilation solutions, careful analysis of the project is required in terms of design compliance and fine control strategies. The design should be solution-based not led by one specific product. A single controls solution should be delivered by a single provider with a single point of responsibility.

Solutions providers must be able to deliver strong specifications and proof of their ability to comply with them through live data logging, post occupancy evaluation and client testimonies.