**Good Design is only part of the story.**

We spend a large proportion of our lives indoors and yet many people don't realise the adverse effects that poor IAQ (indoor air quality) can have on our day-to-day well-being and productivity. We perhaps pay even less attention to the energy cost of delivering this air. But what is the purpose of heating, ventilation and air-conditioning: to meet building regulations or to provide a healthy space in which to live and work? I'd suggest the latter with the additional caveat that this should be done as energy efficiently as possible. Modern building designs strive for greater air-tightness in the pursuit of reducing energy consumption, but at what cost to the quality of the air we breathe? During his recent visit to Loughborough University, ASHRAE President Bill Bhanfleth remarked *"In this push for dramatic changes in the energy use intensity of the building sector, it is essential that the fundamental importance of indoor environmental quality, particularly indoor air quality, not be lost".*

Natural ventilation is a possible solution to the challenge of providing fresh air at low energy cost. The idea of using nature's forces of wind and buoyancy to provide building occupants with an adequate supply of fresh air is nothing new: in my lectures I regularly use the London House of Commons example from 1836 where a furnace was used to draw stale air through ducts connected to the top of the debating chamber. Buildings of the late 20$^{th}$ and early 21$^{st}$ century use a similar principle, only now the architectural form of the building is skilfully developed to incorporate ventilation stacks which use the heat gain inside the building to enhance the ventilation flow. This has been very successful in buildings such as the Queens Building in Leicester and the Frederick Lanchester Library in Coventry, both in the UK. In less forgiving climates, such as the continental US, why not consider natural ventilation as part of a hybrid solution in the quest for reducing energy whilst maintaining good IAQ? Again, this has been done successfully at Judson University, Illinois, where a hybrid strategy for the Harm A Weber Academic Center has led to an exceptional working environment and reductions in electricity and heating demand.

Admittedly, the design of an advanced natural ventilation strategy is not straightforward and requires the design team to pay careful attention to minimizing internal heat gains by providing solar shading, good day lighting, and exposing thermal mass where possible. Notwithstanding these important design principles, exemplar case studies have been published and such designs are based on sound principles of building physics. So the knowledge is out there to enable us to develop good, natural (and hybrid) ventilation designs. Unfortunately, good design alone rarely meets all the needs.

Regardless of how good the natural or hybrid ventilation design, it fails as a low energy solution without due respect to *the 3 Cs*: Control, Commissioning and Client understanding.

Control is needed to ensure the free area of large ventilation openings, required during warm weather for ventilation cooling, can be significantly reduced during periods of heating to ensure sufficient ventilation for good IAQ without unnecessary heating energy costs. It may be necessary to control actuators differently in summer relative to winter to achieve this.

Commissioning can be difficult as the guidance on how to do this for innovative ventilation strategies is limited. After all, by their very nature, such buildings are often bespoke. It is therefore important that the design team make clear to the commissioning engineer the intended operation of the ventilation strategy. Even when this is done, it is almost impossible to reproduce the operating conditions likely to be encountered during the seasonal variations of a full year. In which case, fine tuning of the building during its first year of operation, either by the client or retained members of the design team, will pay dividends, both from an IAQ and energy performance point-of-view. But this requires communication with the client.

Client understanding of how the ventilation strategy is intended to work is essential. Not only does this enable the client to play a role in fine tuning, but it also helps facilities management maintenance teams to diagnose problems highlighted by the Building Management System and can prevent ‘mission critical’ ventilation openings being obscured by book cases and other furniture, misplaced by uninformed occupant!

Don’t be put off! Instead, be challenged to develop low energy solutions which deliver exceptional working environments and stunning architecture.

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