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Design and control of passive ventilation in multi-storey buildings

Period of Study: 2010- on-going

Supervisor: Professor G. R. Hunt

Description of Research

Passive stack-effect ventilation is becoming an increasingly popular low-energy building design feature. It has particular potential for use in tall buildings and can work hand-in-hand with significant architectural features such as atria, solar chimneys and glazed double façades.

However, the integration of stack ventilation into large buildings has met with mixed success. Whilst some designs have become benchmark low energy buildings, others have not performed as expected, requiring redesign or even reverting to an energy intensive mechanical HVAC solution.

With this in mind, my work focusses on developing a preliminary design approach for large naturally ventilated buildings based on the fundamental physics governing the movement of air and heat through interconnected spaces.

Work completed to date includes the development of analytical design solutions for buildings with an atrium, solar chimney and/or inlet plenum to provide sufficient ventilation to ensure a comfortable internal environment in a number of building usage scenarios. The work has also been extended to inform ventilation control strategies, in which temperatures and flow rates can be varied in one zone in a building, without affecting air and heat flows in adjoining zones.

Future work includes exploring design parameter space for a two-storey building with an atrium, focussing particularly on cases where multiple steady state flow regimes are possible. An exploration of the transient behaviour of large naturally ventilated buildings is also planned.

This work will be used to inform the design of experiments intended to follow the Ph.D. project, and also to inform preliminary design guidance for engineers and architects involved in sustainable building design.

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