Investigating the fluid mechanics of hybrid ventilation.

A low energy ventilation system is often incorporated as one of the major energy saving measures in a new or retrofitted sustainable building design. Such systems generally employ a hybrid ventilation strategy in which the airflow driven by natural pressure forces is assisted by mechanical equipment, governed by a computer controlled building management system.

This study aims to extend the use of analytical models, based on extensions of the theory developed by Linden et al. (JFM, 1990) to ventilation strategies employing a combination of natural and mechanical systems; thereby enhancing the currently limited understanding of hybrid ventilation.

My research focuses on development of simplified mathematical (analytical) models to describe the variation of density and pressure within and hence determine the flow rate through a ventilated enclosure of simple geometry.

Work completed to date involves identification of a critical time and critical heat input, for which the hybrid ventilation system results in identical conditions to an equivalent solely natural system. These results are significant for sustainable building design in terms of selecting the optimal ventilation strategy during the design stage. Models have been developed which describe enclosures with single and multiple openings near the top and base, with zero and non-zero buoyancy input.

Future work involves validation of these mathematical models by comparison against experimental results from small scale physical modelling; a technique which makes use of positively and negatively buoyant aqueous solutions in a fresh water environment to simulate warm and cool air. Once the analytical and experimental modelling phases of the research are complete, the outcomes of the study will be collated to produce a set of guidelines, giving advice and recommendation on application of hybrid ventilation systems.

Owen Connick
Fluid Mechanics Research Student
Department of Civil & Environmental Engineering
Imperial College London
SW7 2AZ
(+44) 07818842379
owen.connick05@imperial.ac.uk