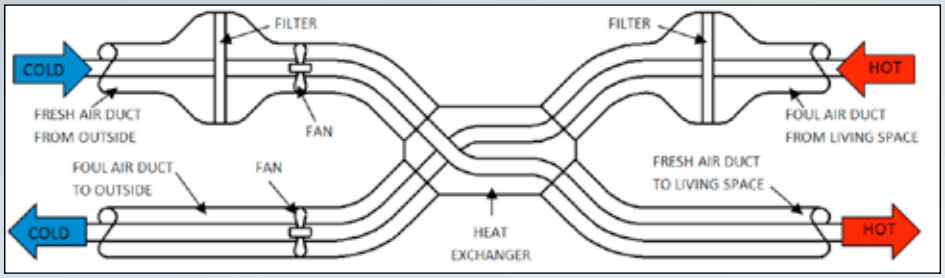
Case Study

WASTE HEAT RECOVERY SYSTEMS

Simultaneously heating and ventilating a building wastes the heat that is transported out of the building as ventilation discharge. A Waste Heat Recovery System (WHRS) uses discharged air to heat air entering the building via a heat exchanger.

In maximising WHRS efficiency, energy savings due to heat recovery must be offset against electrical energy usage of fans and other components.

DesignFlow was commissioned by Vent-Axia Group Limited (a leading manufacturer of domestic and commercial HVAC products) to analyse and improve one of their prototype WHRS systems, to reduce electrical energy usage and reduce noise.



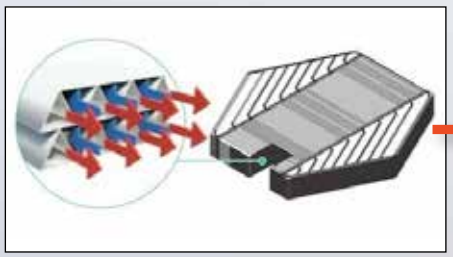
Typical WHRS layout

The major challenge in this type of project is to develop simulation methodologies that are sufficiently fast and cost effective to provide timely input into product design cycles. A range of simplifications and assumptions are needed to make this possible. Experimental validation is therefore important to quantify errors associated with such simplifications.

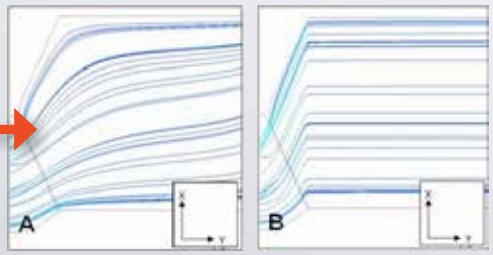
However, once adequately validated the simulation becomes an invaluable tool for understanding where energy is being wasted, and modifying the design as a result. Multiple virtual design iterations can be carried out relatively quickly without the need for further physical prototypes, assessing the effects of changing a wide range of design parameters/geometries.

Using this approach, the electrical power required to overcome system pressure losses in the prototype WHRS was approximately halved* and system noise was significantly reduced.

An example of a simplification to minimise analysis cost is the replacement of complex device geometry (such as heat exchanger channels) with mathematical models that are embedded in CFD simulations.



Typical thermoplastic plate heat exchanger (Recair bv)



Mathematical modelling of losses embedded within CFD simulations. (A) Isotropic Porous Loss, (B) Directional Porous Loss

"DesignFlow's approach to using CFD to improve the efficiency of products we are designing has been of considerable value to us, helping to support our continued development of world leading heating and ventilation equipment. Rather than "just running some CFD", they put much effort into understanding our engineering requirements and constraints, and tailor their approach to provide realistic, practical design solutions. Validation of CFD against experimental data gives us confidence that results are reliable.

This provides much more than a set of CFD results; DesignFlow's explanations give us a fundamental understanding of the flow in a prototype device, and how their proposed design changes can improve performance. As such, we have seen much more significant improvements in energy efficiency and reduced product noise than could have been achieved by a purely experimental approach."

Alan Saunders, Group Product Development Manager, Vent-Axia Group Limited.

* excluding the fixed power required to overcome heat exchanger pressure loss.

UNIVERSITY OF PLYMOUTH

DesignFlow is a specialist consultancy and research group operating within Plymouth University. We offer a range of CFD, engineering analysis and product development services to industrial clients and research partners.

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