What is displacement ventilation?

Displacement ventilation works by deliberately inducing stratification in the room air. Cool (but not cold) air is supplied at relatively low velocities at low level and spreads across the floor. Warm air, such as the air flowing off equipment or people then rises within the room.

A major benefit of displacement ventilation is that it is very effective at removing contaminants from the occupied zone and collecting it at high level, where it is then extracted from the space. Occupants in a room conditioned by a displacement system will typically experience a much improved indoor air quality and thermal comfort.

The Maroondah mental health project involved two stages each of 25-bed inpatient units, in a new freestanding facility.

Designing for displacement ventilation

Through discussion with Eastern Health and the Department of Health, the following were agreed with respect to key design issues:

- The displacement diffuser face will be of robust, high-security perforated steel plate type, and must be removable for installation and maintenance access.
- Detailing of diffuser will be designed to inhibit liquids (such as urine) from entering the ventilation duct.
- No moving parts within the displacement terminal is preferable for ease of maintenance, however this would preclude mixed mode operation capability.
- Transfer grilles to ensuites will be designed to prohibit self-harm.

Particular attention to the design and implementation of ductwork droppers within the wall construction was required.

Air-to-air heat exchangers were employed to transfer thermal energy from the exhausted air to 100 per cent outdoor air supply systems. This further improved energy efficiency, as well as indoor air quality by recovering waste heat into full fresh air make-up.

The low level diffuser was designed and tested to withstand physical abuse by the project team, involving the architect, ESD consultant, mechanical engineer and building contractor.

Three trials were necessary before achieving the required strength for the diffuser unit.
Project outcomes

Dynamic thermal modelling conducted during the schematic design has shown that this system approach will perform well in the bedrooms. The required air quantity is similar to the amount of toilet exhaust extracted from the ensuites. This generally means that no air will need to be returned from the rooms to the corridors, which will reduce costs and eliminate an acoustic transfer problem from the rooms to the corridor.

Air is extracted via high level transfer grilles and acoustic ducts into ensuite exhaust systems.

‘…feedback from staff, patient’s, visitors and management is consistently positive regarding the design and “feel” of the facilities.’

Karen Fox, Eastern Health.

The displacement and heat recovery systems added $102,000 to the capital cost. Compared to a conventional system, displacement ventilation is expected to reduce energy consumption, energy costs and greenhouse emissions by over 14 per cent. It is difficult to quantify the indoor environment quality benefits, such as patient well-being, though this does not mean that the benefits do not exist.

For further information

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Further case studies and the Department of Health Guidelines for sustainability in health care capital works can be found at http://www.capital.health.vic.gov.au/Sustainability/

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