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HOW TO RECONCILE

The new building regulations which come into force later this year show that the Government recognises the importance of controlling the building up of moisture and indoor air pollutants in the home. *John Willoughby* shows how designers can meet the need for adequate ventilation without wasting excessive energy.

In the past, little attention has been paid to the question of coping with indoor, rather than outdoor, air pollution, despite the fact that most of us spend as much as 90% of our time inside buildings.

The reason is that older, leakier, buildings usually provide more than enough air for adequate ventilation. But, as the need to save energy has grown in importance, so has the recognition that airtightness is a very cost-effective way of saving money.

Fortuitous air infiltration in buildings is being cut to a minimum, making it essential to give careful thought to alternative ways of providing fresh air.

Recent field trials, on low energy houses at Milton Keynes, carried out by the Open University Energy Research Group, have shown that it is quite easy to produce houses with relatively low infiltration rates.

Draught lobbies, good standards of weatherstripping and care with constructional details helped to reduce the infiltration rates in these houses to around 0.3 air changes per hour.

With more sophisticated construction techniques, using continuous vapour barriers, triple glazing with high performance seals and so on, it is possible that infiltration rates can be reduced to even lower levels.

But at such low air change rates there is a real danger of problems due to a build-up of water vapour resulting in condensation and an increase in indoor pollutants, such as radon, carbon monoxide and formaldehyde (see *Building* 9 December 1983). Ventilation is by far the easiest way to combat these problems.

Faced with the threat of condensation and mould growth and the build-up of dangerous gases, the designer might be tempted to ensure that the building is made sufficiently leaky by, for instance, omitting some of the window seals. This might solve the problem but only in an uncontrolled way. On windy days there would be excessive ventilation and during windless periods there might be too little.

The solution must be to *control* infiltration by sealing the building as tightly as possible, introducing ventilation in a controlled manner when and where it is needed.

There are several ways of achieving controlled ventilation, and either natural ventilation or mechanical systems can be used as the basis of their operation.

Natural ventilation relies on wind pressures or the stack effect generated by the difference between indoor and outdoor temperatures. Mechanical systems use fans and ductwork to push the air around the house.

The most common form of natural ventilation system is the open window. While being essential for summer cooling, opening windows for ventilation in winter is hardly satisfactory. Typically an open kitchen window will allow ventilation rates anywhere between 6 and 15 air changes an hour.

Better control can be achieved by using sliding double glazing. But generally something more subtle than the open window is required.

Trickle ventilators, built into the window head or the glazing itself, are now becoming a more common solution for controlled natural ventilation. An Energy Efficiency Demonstration Project has looked at their use in housing at Abertridwr. The project was monitored by the Welsh School of Architecture at UWIST and the results indicate that the use of the Titon trickle ventilators does reduce window opening. And condensation problems were significantly reduced in the houses fitted with trickle vents.

Ventilation rates through trickle ventilators tend to be variable because they are mainly dependent on wind pressures. The "passive" ventilation system developed jointly by Pilkington Brothers and TRADA (see *Building* 8 February 1985) uses Titon Trimvents to supply air to a natural ventilation system which relies on the stack effect. This system uses vertical ducts connecting the kitchen and bathroom to a ridge vent to ensure a background whole house ventilation rate of about 0.3 ac/hr.

Further, even these low air change rates can represent a continuous heat loss of over

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250 W (amounting to 1500 kWh/year). But this loss can be reduced if the ventilation air is introduced to the house via a passive solar conservatory. The conservatory can be used to preheat the ventilation air in winter and add to summertime ventilation (see *Building* 1 February 1985).

As the awareness of condensation and indoor air pollution has grown, a number of firms have introduced product ranges specifically to deal with the problem.

For example, Vent Axia has set up an indoor air pollution unit, advising on the need for adequate ventilation, while Willan Building Services has promoted the use of passive systems, requiring the minimum amount of tenant involvement, with its Passivent range, the first elements of which were launched last April.

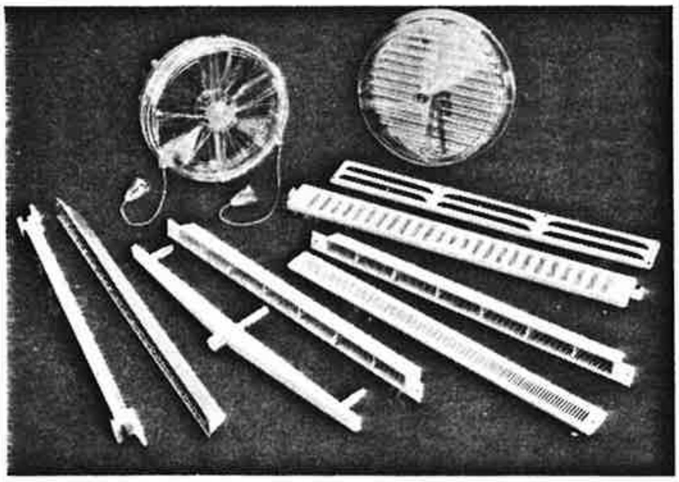
The full system will comprise adjustable through-wall ventilators with telescopic sleeves (*Building* 17 May, page 97) which act as air inlets, with extractor vents sited in the ceilings of kitchens and bathrooms. These discharge through a roof vent incorporating a mechanical fan terminal.

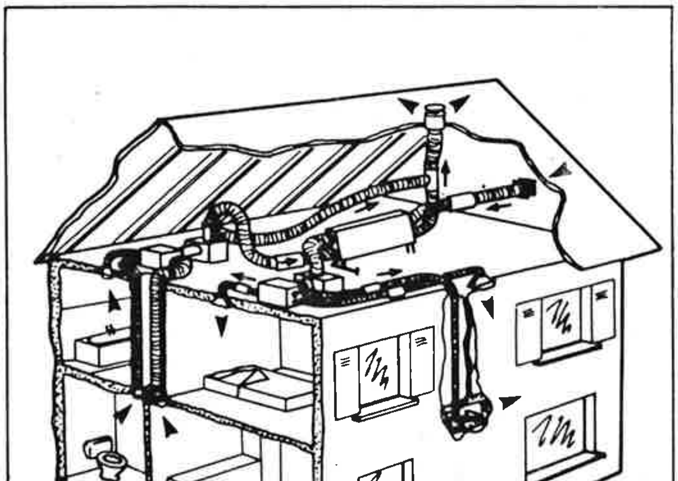
A range of window and window head vents is soon to be added to the system, as well as special louvered ventilators meeting the British Gas Council's ventilation requirements.

With ventilation remaining a complex field of building science, Willan went to the University of Manchester Institute of Science and Technology for help in developing Passivent.

Ventilation options

Option	Controllability	Cost excluding installation
Natural		
Opening windows	Poor	—
Trickle ventilators	Medium	£6
Passive system	Medium	£60
Mechanical		
Extract fan	Medium	£110
Heat recovery unit	Medium	£150
Whole-house heat recovery	Good	£1000





The option open to designers to tackle indoor air pollution range from passive ventilation devices, like these (*above*) to be introduced shortly by Willan, to whole-house ventilation of the type offered by Aldes ventilation, which incorporates a roof heat exchanger.

Mechanical systems

Because the performance of natural systems relies on variable weather conditions, some people may feel inclined to invest in a mechanical system which can guarantee a predictable air change rate at the flick of a switch.

The most basic system is a simple wall or window fan. These can be sited in the moisture-producing bathrooms and kitchens and be selected to give 5-15 ac/hr in those rooms. Such simple systems have several disadvantages: they rely on someone remembering to switch them on; they can represent a large heat loss if they are left running; and in very well sealed houses, their intermittent use may not produce the background ventilation need to avoid the build-up of indoor pollutants.

Switching can be controlled by a humidistat which switches the fan on at a pre-set humidity level. This is a good idea, but the position of the humidistat needs careful consideration because its characteristics will alter if it is coated with grease from cooking (extract fans able to melt off the grease have been successfully tested by the GLC).

It is, however, more difficult to maintain a satisfactory background ventilation rate and avoid excessive heat losses with simple extract systems.

Heat recovery

The next logical step is to supply controllable mechanical ventilation, avoiding excessive ventilation heat losses by introducing heat recovery.

This can be done locally using a heat recovery room ventilator such as the one manufactured by Toshiba. This uses a plate heat exchanger to transfer the heat in the exhaust air to the supply air drawn from outside. These localised units have a quoted efficiency of around 60-80% and cost in the region of £150. But while these heat recovery units deal with the problems of excessive localised heat loss, there still remains the issue of providing a satisfactory whole-house ventilation rate.

In very well sealed, highly insulated buildings with infiltration rates below 0.2 ac/hr, it makes sense to provide a whole-house heat recovery ventilation system. These systems use air extracted from kitchens and bathrooms to pre-heat fresh air supplied to living rooms and bedrooms. Added sophistication, in the Greenwood Airvac system for example, allows air to be supplied just to living areas for pre-set times during the day (larger cross-flow heat exchangers can give heat recovery efficiencies of around 70%).

These whole-house systems cost about £1000 (excluding installation costs). This sounds a high cost but if the system is used for heating as well, then the cost of a wet central heating system is reduced considerably.

But to provide heating using the very small air flow rates involved (whole-house ventilation rates of 0.5-1.0 ac/hr) implies that the heating load must be very low.

This system is to be used on new super-insulated houses which are being built at Milton Keynes. They use a Finnish timber-frame system with an integral vapour barrier and high performance triple glazing. Infiltration rates are expected to be less than 0.1 ac/hr. A Bahco whole-house ventilation system will supply 0.75 ac/hr with heat recovery from exhaust air.

The high levels of insulation (300 mm loft insulation, 180 mm in the walls, 100 mm in the floor and triple-glazed "Kappafloat" windows) have reduced the space heating load to a mere 2 kW.

Predictions carried out by the Research in Building Group at the Polytechnic of Central London estimate that the heating costs for these houses will be less than £40 a year. Compared with a conventional house this represents a saving of around £260 a year, which suggests that using highly insulated, well-sealed buildings with controlled heat recovery ventilation may well be the way forward for low energy house design.