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Passive stack ventilation in dwellings

Proposed changes to Approved Document F, which describes ways of satisfying the *Building Regulations* (England and Wales) governing ventilation, will allow the use of passive stack ventilation ducts as an alternative to mechanical extract fans. *Christine Uglow* and *Roger Stephen* describe how a passive stack system works.

Ventilation in dwellings is something which, all too frequently, happens by accident rather than by design. For naturally ventilated dwellings, the current requirement is to provide a ventilation opening equal to 1/20th of the floor area in each room, with no specific requirement relating to the provision of background ventilation.

While this might have been acceptable when dwellings had several ventilation openings such as fireplaces and airbricks, there is growing evidence that ventilation provision in dwellings needs to be given greater attention.

There are two relatively simple and inexpensive ways of improving ventilation; first by providing controllable background ventilation, using purpose-provided secure ventilators, and second by providing extract ventilation in kitchens and bathrooms, to remove moisture at source.

To date, there have been only a few UK field studies of how passive stack ventilation (psv) systems perform in practice; however the results are promising and suggest that there is a role for psv in both existing and new dwellings. A number of design points have already been established which will assist those considering or involved in the installation of psv systems.

PSV design

A typical psv system layout is shown in Figure 1; it can easily be adapted for single storey dwellings.

For optimum performance, ducts should be as near vertical as possible and should be well supported. However, if the ducts are to terminate on the roof ridge (the preferred option) some bends in the system are inevitable.

These changes in direction should be as few as possible and of the "sweep" rather than "sharp" type. No bend or section of the ducting should be at an angle of more than 45° to the vertical.

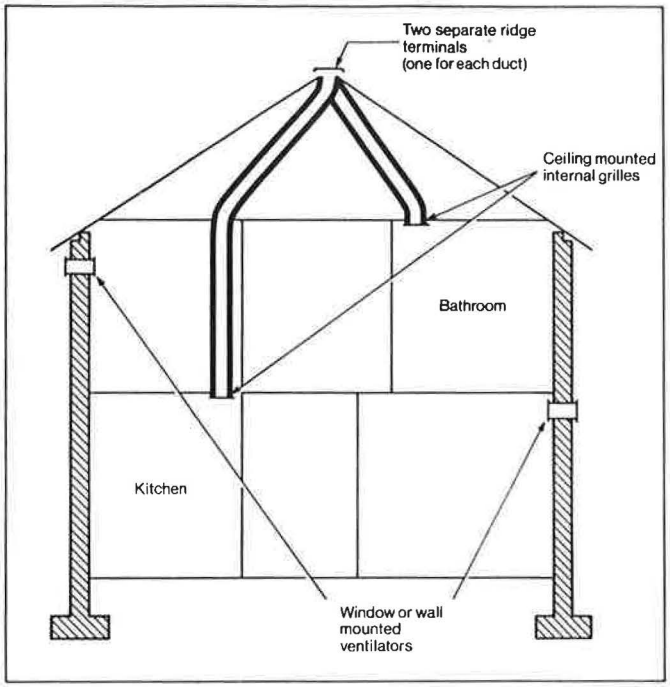

Figure 1: Passive stack ventilation system

To achieve an adequate but not excessive air flow rate, the diameter of the ducting should be between 100 and 150 mm. Proprietary upvc ducting, of the type used for drain pipes, is suitable and has the advantage of offering low resistance to the flow of air.

Flexible ducting, although more expensive, has the advantage of being easy to install, particularly in the roof space where the need for rigid bends is eliminated. However, the corrugations in the duct wall introduce increased resistance to the flow of air.

The ducts should be insulated with at least 50 mm of insulating material wherever they pass through an unheated space, in order to prevent moisture in the outgoing air from condensing and running back down into rooms below.

The two ducts should not be manifolded together, because there will be isolated occasions, usually associated with high wind speed, when reverse air flow, ie, down the duct, may occur. Although this is believed to be rare, a common outlet terminal could result in air from bathrooms being routed into kitchens.

Outlet terminals

The positioning of the outlet terminals is constrained by the need to ensure, as far as possible, that air flow in the ducting is not unduly affected by changes in wind speed and direction. The preferred solution is for the ducts to terminate at outlets on the roof ridge, using standard ridge terminals with appropriate adaptors. If, however, the ducts penetrate the roof away from the ridge, the duct has to be extended at least to ridge height[1] to ensure that the outlet is in the negative pressure region above the roof. If this is not done, the outlet will often be subject to positive pressure, leading to likely reverse flow down the duct.

There are further disadvantages to this arrangement - the visual impact and the likelihood of moisture condensing in the cold external part of the duct and running back into the dwelling.

For aesthetic purposes, grilles should be provided on the inlet ends of the ducts. They should present the least possible resistance to the flow of air - the concentric ring and egg crate types are suitable - and should be easily removed for regular cleaning.

Air supply

If the psv system is to work effectively as an extract system, the dwelling must have an air supply, preferably by means of purpose-built ventilators rather than adventitious gaps and cracks in the dwelling fabric. This can best be achieved by controllable background ventilators; each dry room of the dwelling should be fitted with a purpose-built ventilator having a free area for the flow of air of not less than 4000 mm^2.

In order to develop more refined design guidance, a number of aspects of psv system design and performance are under investigation in current BRE projects. These include changes in the type and size of ducting, the type and position of outlet terminals and the transfer of external noise down the ducts, particularly from busy roads, railways or airports. In addition, field studies will shortly commence in occupied dwellings fitted with psv systems, so that reaction, an important aspect of any ventilation system, can be examined.

[1] Nederlands Normalisatie Instituut. Ontwerp NPR 1088. Ventilatie von woongebouwen; toelichting op ontwerp NEN 1087. Rijswijk, 1974.

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