Controlling ventilation in high rise flats

The ability to control ventilation rates is one of the key factors in improving the habitability of large panel system blocks of flats. BRE's programme of on-site air-leakage measurements is leading to guidance on improved ventilation provision. *Christine Uglow* and *Roger Stephen* report progress.

Condensation and mould are problems frequently found in dwellings of large panel system, lps, construction, usually resulting from a combination of "cold bridging", poor standards of heating and inadequate ventilation. Measures to improve provision for ventilation can be relatively straightforward, particularly if repair or refurbishment work is at hand.

Most high rise lps blocks are at least ten storeys high and some have as many as 30 storeys. At these high levels, the wind pressures acting on the building surfaces are several times greater than those experienced by low rise, suburban housing. Even on the lower levels of a high rise block, the wind environment can be hostile. For these reasons, ventilation rates in high rise flats, during the heating season, tend to be dominated by the effects of wind, rather than the effects of temperature difference (stack) which dominate in low rise housing.

A second important ventilation characteristic of lps flats is their air tightness, as compared with traditional housing; a factor which emerged during recent BRE studies. In some respects, improved air tightness is almost essential in these tall buildings, since it lessens the effects of extremes of wind and cold weather.

In all dwellings, the infiltration of air through gaps in the fabric ensures a certain background level of fresh air entry, even when all purpose-provided ventilation openings are closed. However, in high rise flats in particular, it is impractical to rely on air infiltration alone as a means of ventilation, because of the sensitivity to wind conditions and the lack of control available to occupants. Even in a relatively airtight flat, the infiltration rate can increase by a factor of ten from a calm to a windy day.

The best way of providing ventilation is to complement background infiltration with finely controllable, purpose-provided ventilation, designed so that openings do not pose a security threat and do not cause draughts. Fine control is essential if occupants are to use ventilators to meet their varying requirements, especially during windy weather.

However, in the majority of lps flats, openable windows and fixed airbricks are the only means of providing ventilation. Windows are usually very large and have poorly-designed hardware, resulting in high ventilation rates, even when the window is open only to the first stop. Fixed airbricks are often blocked by occupants in an attempt to prevent draughts or reduce heating costs. Clearly there is room for improvement in the specification of purpose provided ventilation.

As a first step towards developing detailed guidance, BRE has carried out a programme of measurements of air leakage rates in high rise lps flats to determine likely background levels of fresh air infiltration. Site measurements have been made in a total of 87 flats in Glasgow[1] and London, covering six lps systems: TWA, Harley Haddow, Bison, Skarne, Reema and Tracoba.

The technique used was fan pressurisation[2], in which a portable fan assembly is sealed into the doorway of the dwelling to measure the air flow rates at a series of pressure differences in the range 10 to 60 Pa. Each dwelling is characterised by a graph of air flow rate versus pressure difference. In line with international convention, the results are analysed to give a leakage rate, expressed in air changes per hour at an applied pressure difference of 50 Pa. Note that this pressure difference is much higher than the pressure differences which drive natural ventilation.

Figure 1 shows the 50 Pa air leakage rates of 87 lps flats; the overall mean is 7·3 ac/h. In comparison a sample of 100 "traditional" UK dwellings of semi-detached or terraced construction gave a mean of 11·5 ac/h^2.

The different lps systems exhibited a range of leakage rates, varying by a factor of up to two for nominally identical flats. This is due to a number of factors, including quality of windows, maintenance and internal furnishings such as carpets; it also shows the need to tailor ventilation provision to the specific circumstances.

In a fan pressurisation test, the measured air flow rates represent leakage through the entire envelope of the dwelling, including cross leakage through party walls, floors and ceilings. Cross leakage is particularly important in flats, since if it represents more than a few per cent of the total leakage, the natural infiltration rate of fresh air will be less.

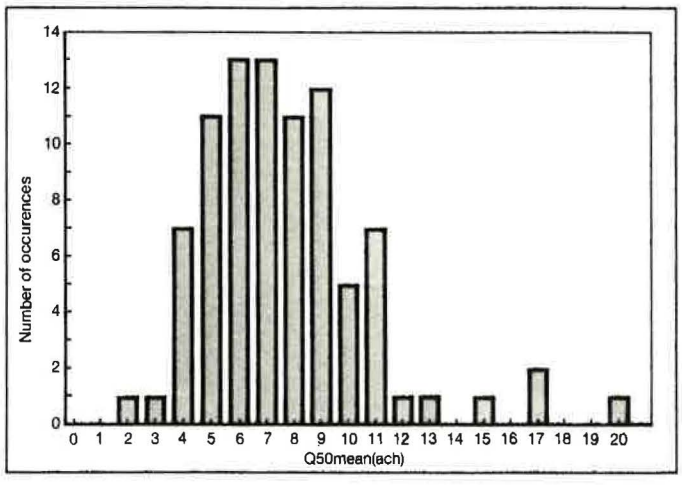

Figure 1: Leakage rates, at applied pressure difference of 50 Pa, in 87 lps flats.

Preliminary analysis of the cross leakage measurements made in 13 flats indicate that, on average, cross leakage accounts for 10% to 20% of total leakage. The implications of this in terms of air infiltration, noise and the transfer of smoke, are being considered.

In some flats measurements of the contribution made by windows to overall leakage rates were made in order to assess the likely effects of draughtproofing, or replacement windows. It was found that a reduction in background air infiltration of up to 30% could be expected following effective draughtproofing of windows, or the installation of high performance windows.

Air leakage test results are now being used to estimate air infiltration rates in typical lps flats under varying conditions of temperature, wind speed and wind direction. Predictions are also being made of how the height of the flat and the number of exposed walls affects the performance of ventilation openings and extract fans.

The results of this work will lead to detailed guidance on ventilation provision in high rise lps flats, which, together with guidance on other aspects of habitability, will be published early next year. It is clear from the studies completed so far that, in general, there is a requirement for improved ventilation provision in all habitable rooms of lps flats, with the emphasis on fine control by occupants.

References

1 Measurements in Glasgow were carried out by the mechanical and offshore engineering group of the University of Strathclyde, under contract to BRE.
2 C Uglow *Measuring air leakage*, 2/86 *Building Services*.

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