With respect to air, the traditional British house has been too leaky. So there has been much emphasis over the last decade on improving airtightness. From this hectoring, it has been easy to get the impression that the more airtightness the better. This is not necessarily the case. (See Footnote 1: Too much airtightness?)

The theory of ventilation shows how much ventilation is required for the health of the occupants and the health of the building, and it shows the size of the heat/energy losses that result. But the theory is both difficult and fuzzy. What the house designer/builder needs is some guidance about optimal airtightness in order to set a figure for the design air permeability. Unfortunately, such guidance is hard to find, especially for the less common ventilation systems.

If a house is too leaky, it will sometimes be over-ventilated – depending upon the weather conditions and the rate of production of pollutants inside the house at the time. When there is over-ventilation, an appreciable amount of heat is lost unnecessarily. To cut ventilation heat losses to a bare minimum, Heat Recovery Ventilation is required, and in this case the received wisdom is that the house should be as airtight as possible. However, most new houses are ventilated naturally, not mechanically. For natural ventilation, total airtightness is unnecessary. It is futile to seal all the cracks in the fabric of a house when that will result in future occupants having to keep all the trickle vents open in order to achieve sufficient ventilation.

Building Control procedure

You need to decide at an early stage whether or not you intend to have the airtightness of your house tested. (Testing is optional for a development of one or two dwellings, eg, a selfbuild. As mentioned last month, you might choose to have an airtightness test done in order to reduce the Dwelling Emission Rate and to improve the SAP rating.) If you do intend to have a test, you are required under Part L1A to state the design air permeability (q50) when you submit your plans to Building Control.

The design air permeability is a statement of your intent. But arriving at a particular value in practice is not easy. Once the house has been built, the blower-door test might show that the measured q50 is greater than the design q50. This is acceptable as long as:

- The measured q50 does not exceed 10 m³/ h.m² (at 50 pascals pressure).
- When the measured q50 is incorporated into the Standard Assessment Procedure (SAP), the Dwelling Emission Rate (DER) does not exceed the Target Emission Rate.

(For an explanation of q50, the air permeability, and n50, which is used below, see last month’s article.)

The value for q50 can have a significant effect on the DER. A recent publication by the NHBC shows that reducing q50 from 10 to 5 improves the DER by about 6%. (See Further Info.) Improving airtightness can be a cost effective way of reducing future heat losses. But don’t make your home too airtight. The optimal airtightness depends on the ventilation system you intend to install. (We’ll be looking at different ventilation systems in a later article.)
Levels of airtightness

Here are some markers for different values of air permeability, q50:

- \( q_{50} = 15 \text{ m}^3/\text{h.m}^2 \) (at 50 Pa)
  According to Approved Document L1A, if you choose not to have an airtightness test, \( q_{50} = 15 \) is the default value to be entered into SAP. (But is it really the default value? See Footnote 2.)

- \( q_{50} = 11.5 \)
  This is the average air permeability of the UK housing stock.

- \( q_{50} = 10 \)
  This is the maximum value allowed by Approved Document L1A (if you have an airtightness test carried out).
  In SAP, \( q_{50} = 10 \) is the reference value when the Target Emissions Rate is evaluated; and it is also implied as the default value for a typical masonry house. (See Footnote 2.)

- \( 3 < q_{50} < 7 \)
  This is the range of airtightness that has been recommended by the NHBC for natural ventilation. The Energy Saving Trust has recommended \( 3 < q_{50} < 5 \) as Good Practice. (But see Footnote 3.)

- \( q_{50} < 3 \)
  Heat Recovery Ventilation is viable, and both the NHBC and EST have advised the use of mechanical ventilation rather than natural ventilation. (But refer again to Footnote 3.)

- \( q_{50} < 1 \)
  Generally recommended for Heat Recovery Ventilation.

- \( n_{50} < 0.6 \text{ ach (at 50Pa)} \)
  Requirement for Passive House certification. [NB: \( n_{50} \), not \( q_{50} \).]

Ventilation resulting from infiltration

A short recap of some of last month’s article may be useful –

With natural ventilation, the long-term average rate of infiltration through cracks, etc is about 1/20 of the \( q_{50} \) figure for air permeability. And numerically, \( q_{50} = n_{50} \) approximately.

For \( q_{50} = 10 \) (the limit for an acceptable airtightness test), we have:

\[
\begin{align*}
q_{50} &= 10 \text{ m}^3/\text{h.m}^2 \text{ (at 50 Pa)} \\
n_{50} &= 10 \text{ ach (at 50 Pa)} \\
\text{Long-term ventilation rate} &= 10/20 \text{ ach (at natural pressures)} \\
&= 0.5 \text{ ach.}
\end{align*}
\]

This ventilation rate is at the lower limit of the range recommended by the Energy Saving Trust (0.5 to 1.5 ach).
So \( q_{50} = 10 \) seems to result in a good ventilation rate. In practice, though, it would result in excessive ventilation in cold, windy weather leading to unnecessary
heat losses. And the use of extract fans and trickle vents could also result in over-ventilation.

Instead, \( q_{50} = 5 \) is a more commonly recommended figure, with the natural ventilation by infiltration being augmented by the use of extract fans and trickle vents, as required.

**Approved Document F (Means of Ventilation)**

There are two Approved Documents which influence the design air permeability. As we saw above, Approved Document L1A (Conservation of Fuel and Power in New Dwellings) sets an upper limit, \( q_{50}=10 \). And the lower the measured \( q_{50} \), the better – as far as reducing heat losses is concerned.

Getting sufficient ventilation for good indoor air quality is the concern of Approved Document F (Means of Ventilation), which was last revised in 2010. The previous, 2006 edition was based on an assumption that the lowest air permeability would be \( q_{50} = 3 \). With houses becoming more airtight, the 2010 edition was revised so that it now caters for extreme airtightness, down to \( q_{50} = 0 \) (not that that is possible in practice). For airtight houses (with the design \( q_{50} \) equal to 5 or less), the total equivalent area of trickle vents for natural ventilation has been increased by 40%.

**Trickle vents**

Most modern windows have trickle vents, but how often are they actually used by householders? In cold windy weather, a householder may well close trickle vents to prevent draughts and/or to conserve heat. But in mild, calm weather during the winter does the householder open the vents again? Probably not, I suspect.

In contrast, AD F expects trickle vents to be kept open during wintertime in occupied rooms. ‘Occupied’ is not defined, but I suspect it means a room which is in use, rather than one which has somebody in it. (Eg, a bedroom would still be ‘occupied’ during the daytime. But a guest bedroom would not be occupied if no guest were staying – so its trickle vent could be closed.)

This is one of the ‘fuzzy’ aspects of ventilation theory – the effects of human behaviour. I suspect that only in a minority of houses are the trickle vents kept open all the year – even though the indoor air quality suffers.

So it is my view that a low level of ventilation due to involuntary infiltration is likely to be more dependable than controllable ventilation via trickle vents – which might too often be kept closed. That is to say, extreme airtightness for a naturally vented house is not desirable.

As noted previously, if the design \( q_{50} \) is 5 or less, Approved Document F requires a 40% increase in the total equivalent area of background ventilators. So if you dislike trickle vents, set your design \( q_{50} \) to be just a little greater than 5. (When the house has been built, the measured \( q_{50} \) must be at least 3. See also Footnote 4 for more about trickle vents and their equivalent area.)

There is, though, a big advantage of trickle vents over fabric leakiness (besides the fact that trickle vents can be closed when required). Trickle vents can be located rationally in the different rooms of the house. Fabric leakiness is distributed haphazardly.
Footnote 1: Too much airtightness?

A 2009 publication by the NHBC Foundation draws attention to possible adverse effects of too much airtightness:

*Recent research by the NHBC Foundation has highlighted concerns of homeowners and builders about the possible adverse consequences on indoor air quality of the greater airtightness of the building envelope that is required to improve energy efficiency. Lack of air infiltration could lead to poor air quality since stale indoor air is not replaced at a sufficient rate by fresh outdoor air – with potential for any or all of:*

- pollutants build-up
- high humidity and condensation (leading to mould growth)
- damage to structures
- proliferation of house dust mites.

Footnote 2: Confusion about default value of q50

The building regulations appear to be confused about the value of q50 to be used when no airtightness test is carried out.

The Approved Document for Part L1A seems to be clear enough:

“Avoid the need for any pressure testing by using a value of 15 m³/(h.m²) at 50 Pa for the air permeability when calculating the DER.”

But SAP2009 contradicts this. If a test is not carried out, the method for calculating the DER requires the use of an algorithm (a calculation procedure.) And the algorithm implies a value for q50 which is usually less than 15. For example, for a two-storey house of masonry construction, with a solid floor, a draught lobby, and all the windows and external doors draught-stripped, the algorithm implies q50 = 10 m³/h.m², well below the q50 = 15 stated above.

Footnote 3: Are the NHBC and EST recommendations out of date?

In their 2009 publication, *A Practical Guide to Building Airtight Dwellings*, the NHBC Foundation recommend 3 < q50 < 7 for natural ventilation. But the revision of Approved Document F in the following year has required a 40% increase in the total equivalent area of trickle vents in airtight houses (q50 < 5). With such an increase in the area of trickle vents, q50 < 3 may well result in sufficient natural ventilation.

A similar proviso applies to the EST recommendation (3 < q50 < 5), which comes from their 2006 publication, *Energy Efficient Ventilation in Dwellings*.

Footnote 4: Trickle vents

You need to make decisions about trickle vents (the most common form of ‘background’ vent) when you order your windows. Some joinery manufacturers supply their windows with one vent as standard. You will need to specify not only the size of a window, but also whether you want the window to have 0,1 or 2 vents.

‘Equivalent Area’ was explained in last month’s article – the area of a hypothetical circular hole which would allow the same airflow as that in the test. For trickle vents and other types of background vent, a pressure difference of only 1 Pa is used when
the airflow is measured in the lab. (1 Pa is a typical pressure difference for a trickle
vent in use.)

Corrction

In last month’s article I wrote that the airflow of a blower door is calibrated against
the speed of the fan. In fact, it is calibrated against the air pressure at the fan. The
lower the pressure, the faster the airflow – an example of the ‘Venturi effect’.

Next month: Achieving airtightness.

FURTHER INFO:

* A practical guide to building airtight dwellings  
  NF16. Published by the NHBC Foundation, 2009.  
  40 pages. Free download:  
  www.nhbcfoundation.org.

* Indoor air quality in highly energy efficient homes – a review  
  NF18. Published by the NHBC Foundation, 2009.  
  84 pages. Free download from website above.

* Technical Extra 03  
  Published by the NHBC, September 2011.  
  Includes a graph which shows how the Dwelling Emission Rate varies with air
  permeability.  
  28 pages. Free download:  
  www.nhbc.co.uk.

* Energy efficient ventilation in dwellings  
  – a guide for specifiers  
  GPG268. Published by the Energy Saving Trust, 2006.  
  20 pages. Free download:  
  www.energysavingtrust.org.uk.

Words: 2063.