Airtightness and ventilation

As we push for higher performance from our houses, expectations for airtightness and ventilation are changing rapidly. Some changes will be needed in design to improve airtightness, and mechanical ventilation is likely to soon be the norm.

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ACHIEVING THE IDEAL balance between a warm, airtight home and one that is also well ventilated is possible when attention is given to these details at the design, build and commissioning stages.

With the *Building for climate change* consultation, the government has signalled its intention to dramatically improve the performance of our new builds. This is from both the embodied and operational carbon perspectives - that is, the carbon budget to build a property and the carbon budget to live in it.

It will mean change across the board, affecting multiple aspects of building performance. Thermal performance will need to be better assessed at the design stage - see *Modelling higher thermal performance* on pages 56–57 - and other aspects that affect occupant health like ventilation will need better management.

Why do we ventilate?

Ventilation is needed to remove contaminants, whether this is moisture, particulate matter or chemicals and odours. Its need is driven by health.

Older buildings relied on infiltration - or incidental air leakage - to contribute to total ventilation of a building alongside window opening and extract fan use. However, this is not reliable, and expectations around energy efficiency and health and comfort mean that this is not a valid pathway going forward.

Airtightness and infiltration

Airtightness, on the other hand, is primarily driven by comfort needs. A blower door measurement - or airtightness test - can be used to infer the average infiltration rate. While not perfect, it can give a reasonable indication of the extent of air leakage in service - given a few caveats.

These are the main reasons why airtightness should be considered:

- Reduction in heating load - see *Airtightness trends (part 2)* in *Build* 167. It's not as bad as other aspects of the envelope at present but will become more significant as everything else improves. The main benefit here is the reduction of peak heating load, not necessarily the average.
- Protecting against moisture issues inside the construction - see *Too much moisture in the roof* in *Build* 166. Cold roofs are the first to show signs of issues as there is a steady stack pressure across the ceiling as well as ample leakage opportunity via downlights.
- Improved occupant comfort due to reduction in draughts.

The second point is the most important at present, especially as increasing energy efficiency requirements come with an added

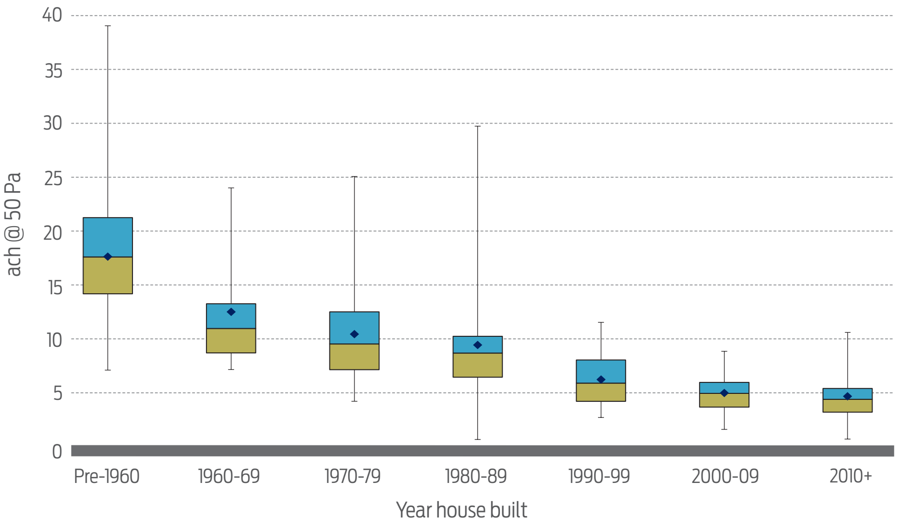

Figure 1: Houses are becoming more airtight over time.

risk of interstitial condensation. Simply put, there will be less drying potential due to reduced energy flow through the different assemblies that make up a building.

Target for airtightness

BRANZ has previously indicated that 3 air changes per hour (ach) @ 50 Pa is a reasonable target for airtightness. Just remember this is the flow at the test pressure, which is significantly more than typical in-service pressures for a building (see *Airtightness of apartments* in *Build* 180). This target will likely be decreasing over time as thermal envelopes improve. From a comfort perspective, it is a good line in the sand and gives a base to start from and improve on over time.

But why 3 ach @ 50 Pa? Based on our database of airtightness testing of homes of various ages and budget levels, nearly 75% of new builds are at or better than 5 ach @ 50 Pa (see Figure 1). This is reasonable given there is no Building Code requirement to achieve this.

It is mostly driven by small details like square stopping of plasterboard and the vast majority of buildings being built on a concrete slab. Plasterboard itself - especially when painted - forms quite an effective air barrier. Improving on this comes down to one thing - the devil is in the details.

Thankfully, simple steps made to what we currently do will only serve to improve the situation - if 5 ach @ 50 Pa is readily achievable without focusing on it, 3 ach @ 50 Pa is not much of a stretch. As better methods become mainstream, this will make it more affordable to implement at the scale we need.

The more this becomes embedded as how we do it, the more likely it will be applied on our existing stock as it is renovated. This should lead to better long-term outcomes for occupant health and comfort.

Simple, practical ways to improve now

Air vapour control layers (AVCL) are one means of achieving airtightness, but there are other simple practical steps that can be taken now to improve what is being delivered. Most only require the addition of sealant to a junction or some extra lining at key points, such as:

- plumbing penetrations - seal using boots
- downlights - use the more modern sealed types at a minimum
- bottom plate junctions - apply sealant prior to skirting boards
- lining behind bathtubs
- internal access garage door - consider an external door or at least a good-quality seal.

Move to mechanical ventilation

With all this talk of reducing leakage, it can't be forgotten that we need to ventilate. Ventilation must be designed for, and while passive options have their place in some buildings, the simplest method going forward will likely be mechanical ventilation.

It is not, however, a magic bullet. Verification that installed systems meet the designed level of performance and are regularly maintained is crucial. All too often when speaking with our collaboration partners around the globe, there are complaints about the poor standard of mechanical ventilation. In France, for example, a high proportion of homes fail their ventilation compliance tests on the first attempt.

Even more airtight in the future

At the proposed final step of *Building for climate change*, it is likely that we will need to build in the vicinity of 1 ach @ 50 Pa. This is readily achievable using conventional techniques and will become even easier using details like those in the PHINZ *High-performance construction details handbook* (a draft version is available on the PHINZ website). To give an example, the BRANZ ventilation test building is below 1 ach @ 50 Pa using a simple modified airtight drywall approach.

In the longer term, there needs to be more testing capacity for both ventilation commissioning and airtightness. This will make it more affordable and improve our understanding of what the industry at large is delivering.

Just remember, it is critical that ventilation systems are well commissioned and maintained as we go forward - especially considering multiple house condition surveys of poor homeowner habits when it comes to maintenance.