

Airtightness of apartments

Recent BRANZ research into the airtightness of apartment buildings has prompted a shift in thinking around airtightness and ventilation. BRANZ now recommends that residential buildings are mechanically ventilated and are built to an airtightness target.

BY GREG OVERTON, BRANZ BUILDING PERFORMANCE ENGINEER

THE AIRTIGHTNESS OF A BUILDING is a measure of how much air flows between indoors and outdoors through the structure itself - in other words, how big the holes are in the structure.

Airtightness is a key aspect of a building's performance, affecting the energy efficiency, thermal comfort and indoor air quality. However, airtightness is only mentioned indirectly in the New Zealand Building Code, and there is no requirement to meet a particular target level of airtightness.

BRANZ tested a range of apartments

Given the growing number of apartments in New Zealand, BRANZ measured different apartment buildings to get an indicative sense of the level of airtightness in the wider stock of apartments (see *Build* 165, *Flat-out testing* for more). While a limited amount of data exists for stand-alone lowrise residential buildings, very little was known about the airtightness level provided by apartments. The BRANZ testing looked at the airtightness of individual units using ISO 9972. The magnitude of inter-apartment leakage was also investigated with additional guarded testing, where multiple blower door fans were used to pressurise more than one unit at a time.

In total, nine apartment buildings were investigated (Figure 1), comprising 148 individual non-guarded airtightness tests. There were no pass-fail criteria for the measurements, given there was no target for any of the buildings.

Airtightness similar to new standalone houses

In general, the apartments were of a similar level of airtightness to what could be expected from a typical new-build stand-alone dwelling - approximately 5 air changes an hour (ach) @ 50 Pa. However, the results suggest a strong dependence on construction style.

For example, for apartment buildings where individual units were separated by concrete fire partitions, the average result was 3.5 ach @ 50 Pa. Inter-apartment leakage appeared to be insignificant in this style of apartment, but inter-apartment leakage did occur in some instances - most clearly when timber partition walls were used to separate dual-key apartments.

Airtightness ranged from 1.9–12.6 ach

In terms of variation across the whole sample, the most airtight unit measured 1.9 ach @ 50 Pa, and the least airtight unit measured 12.6 ach @ 50 Pa. This range of airtightness is understandable, given that airtightness is often not a key consideration when constructing buildings in New Zealand.

Many homes underventilated

The airtightness results in this study are just a snapshot of a limited number of apartments in the stock. In general, the tighter apartments happened to have mechanical ventilation systems and so ventilation should be satisfactory.

However, the measurements sit alongside other data at BRANZ that suggests living spaces in a significant proportion of our housing stock are underventilated unless

Ventilation

FEATURE SECTION



Figure 1: The various types of apartment tested.

reliable measures are taken to purposefully ventilate them.

Accordingly, BRANZ researchers suggest changes in airtightness and ventilation.

Aim for 3 ach @ 50 Pa

BRANZ researchers suggest aiming for an airtightness target. The primary reason for doing this with the current Building Code is to facilitate effective whole-house mechanical ventilation. Mechanical ventilation systems reduce the chance of underventilation.

Energy savings are achieved by building more airtight. However, the reduction in energy loss becomes less pronounced as the airtightness improves. Once mechanical ventilation is introduced, the energy consequence of ventilation is predictable and can therefore be factored into design.

We recommend a target of 3 ach @ 50 Pa across all typologies. Given the airtightness of the buildings we have measured, this is an achievable target for industry with minimal additional cost. At this level, the heat loss associated with infiltration is less significant than losses through many other building elements.

The only way to truly ascertain if such a target has been met is to test the construction, and we expect airtightness testing to become more common in the future. However, given that many buildings are already in the vicinity of this target, simple changes to some common construction details would likely mean most buildings would meet the target if tested. Adoption of such details would reduce the need for an immediate testing regime, easing the regulatory impact.

Move to mechanical ventilation

If the thermal envelope is being upgraded to levels significantly above the Building Code, the heat loss associated with ventilation becomes proportionally more significant. In this scenario, the case for a ventilation system with heat recovery becomes stronger.

For a thermal envelope that is around the Building Code specifications, investment in recovering heat from the outgoing >



ventilation air would be better spent on reducing heat losses from other parts of the thermal envelope, in particular, glazing.

If a non-mechanical ventilation option is desired, it should be validated for efficacy by modelling. Naturally ventilated buildings can work, but BRANZ is proposing that mechanical ventilation becomes the default option.

Only small improvement needed

This represents a shift in our approach to airtightness and ventilation, but how does one go about building an airtight structure? The good news is that, from our measurements, New Zealand houses are often reasonably airtight already and would likely require a small improvement to reach the proposed 3 ach @ 50 Pa target (see Figure 2).

Contrast this with Australia, where a study of 125 modern homes found an average airtightness of 15.5 ach @ 50 Pa. In 2019, the Australian Building Codes Board introduced a requirement of 10 m³/hr.m² @ 50 Pa (approximately 12 ach @ 50 Pa) with optional verification - something that would likely be achieved by most new residential construction in New Zealand.

Resources to help achieve airtightness

Useful resources for helping people who want to achieve an airtight construction for stand-alone dwellings exist, such as the *Air leakage guide* produced by the US Department of Energy and the EPA's *Thermal bypass checklist*.

The *Air leakage guide* is to help meet the requirements of the 2012 International Energy Conservation Code and contains information on what to focus on for air sealing and case studies.



Figure 2: Airtightness of New Zealand houses by date of construction, including apartment data.

For apartments, the Canadian Mortgage and Housing Corporation document *Air leakage control for multi-unit residential buildings* and the illustrated guide *Achieving airtight buildings* by BC Housing provide useful information for the design, construction and testing of buildings.

Common guidance is that effective air control does not happen by accident, and checklists for each stage of construction are encouraged, including having a designated responsibility for each aspect of the air barrier system.

Dealing with air leakage

Recent BRANZ research has highlighted a number of leakage paths that can be addressed with simple measures that can be achieved by the industry with current skill levels. This mirrors the guides mentioned and recognises that the current methods of lining with square stopping or bonded cornices deal with these leakage opportunities relatively well. The major leakage pathways remaining fall under the categories:

- bottom plate/floor/plasterboard junction
- window and door edge sealing details
- plumbing penetrations
- electrical penetrations
- lack of detailing behind bathtubs and fireplaces
- downlights.

A different approach

These suggestions represent a possible transition to the point where airtightness is commonly being measured in New Zealand.

Over time, as the industry becomes comfortable with airtightness as a key consideration, the opportunity remains to revise the target to support further improvements to the overall performance of our buildings. For more See BRANZ Study Report SR455 which will be available shortly at www.branz. co.nz/research-reports.