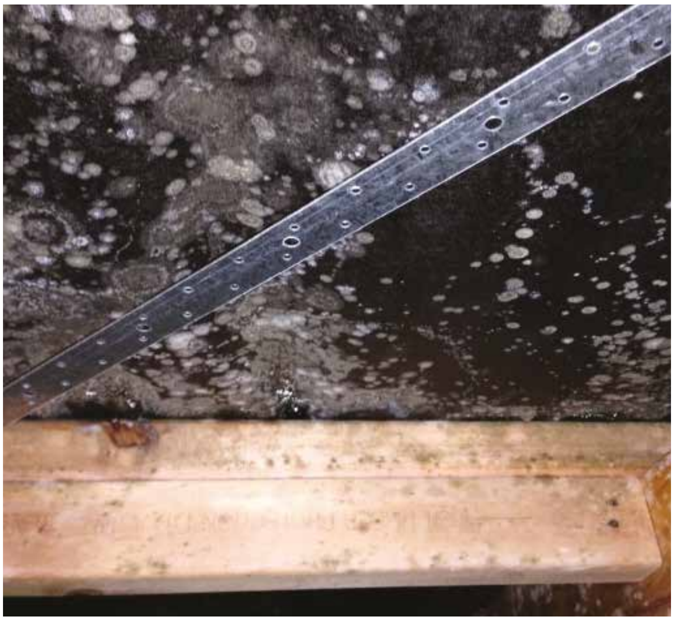
Roof space ventilation in New Zealand houses

New Zealand houses have become more airtight, and there is evidence that this trend extends to the roof space as well. Without proper management of indoor moisture in buildings that are more airtight, mould growth can be a significant issue.



Mould growing on roof framing timber and roofing underlay in an Auckland house.

ROOF SPACE VENTILATION lowers the risk of potential problems such as mould growth. Openings are designed in the building envelope that will allow the exchange of moist roof space air with fresh air from the outside.

Whether or not there is likely to be a moisture problem in a roof space depends on many issues:

- Internal building climate – the roof space is more vulnerable to moisture problems if there is a moisture problem in the living spaces.
- Air permeability of the ceiling – moisture can be transferred to the roof space when air passes through permeable ceiling materials and ceiling penetrations.
- Climate conditions and house location – houses with little exposure to wind and/or sunlight may be more prone to moisture problems.
- Airtightness of the roof space – the more airtight the space, the more likely any moisture that reaches it will accumulate.

New Zealand houses have become much more airtight since the early 1970s as aluminium window joinery has replaced wooden windows and concrete slabs have replaced tongue and groove floorboards. Old villas and bungalows with suspended strip flooring and no sheet lining can have an airtightness (tested at 50 Pascals of pressure) of around 20 air changes per hour (ach). As plasterboard linings, aluminium joinery and concrete slab floors were introduced, the figure dropped to 10–15 ach. More recent construction has come down to 5 ach, and many new homes today are very airtight, with around 3 ach.

Be aware that these are comparative figures and do not reflect actual passive ventilation levels. The ach tests are carried out with a pressure of 50 Pascals – well above typical pressures that drive air infiltration in a house. A house with an airtightness of 3 ach at 50 Pascals will not have anywhere near three complete changes of air each hour. A very rough rule of thumb to find the actual long-term infiltration rate (valid for buildings that are more air-leaky) is to divide the 50 Pascals result by 20.

Greater airtightness has the obvious benefit of making a house easier to heat because air is not escaping through gaps and openings in the envelope. However, improved airtightness also means slower replacement of indoor air with fresh air from outside. If the building is not adequately ventilated, moisture and pollutants can build up over time to a level where problems such as mould can occur.

The same pattern can happen in roof spaces, and this sometimes leads to the same problems. BRANZ scientists have found mould on structural timber and roofing underlay in the roofs of a number of newly constructed buildings.

In most insulated New Zealand houses, thermal insulation sits directly on the ceiling lining. The roofing above is therefore exposed to extremes of temperature. It can fall to temperatures below the surrounding air temperature as heat is radiated into the clear night sky. If the temperature drops below the dew point temperature, condensation starts to form. Where this is removed by ventilation, it will not be a problem, but too much condensation and too little ventilation can lead to the build-up of moisture and eventually the formation of mould. There is also increased potential for other problems such as corrosion.

Roofing material manufacturers often have recommendations or requirements around roof space ventilation where their products are used. Roofing installers should be familiar with these. In some cases, how a building is designed or used may lead to specific ventilation requirements. To quote a BRANZ Appraisal for a proprietary asphalt roof shingle: "If required by the roof design or occupancy, perforated soffit linings, soffits and ridge vents should be used to minimise the quantity of moisture and heat accumulating in the roof space."

Moisture sources

The living areas in a house are a key source of roof space moisture. Bathing, cooking, washing and drying clothes and even breathing all contribute to the air inside a house typically carrying more moisture than the outdoor air.

Moisture moving from living areas into the roof space is most commonly carried in the air. Cracks and gaps in ceilings, spaces around light fittings and so on allow for an upward airflow (see Fact sheet 2 *Testing the airtightness of residential roof spaces in three dwellings* for more on this). In some cases, badly installed extractor fans blow moist air from bathrooms or kitchens directly into the roof space.

For houses on suspended floors, the subfloor space may also be a moisture source. Moisture from wet ground under a house can move through gaps in timber floors into the living areas or in some cases directly to the roof space through wall cavities.

Tackling moisture transfer into roofs

Many steps will help to reduce the flow of moisture:

- Ensure that any extractor fans that vent into the roof space are ducted so that they vent to the outside.
- Take steps to reduce the moisture levels inside a house. Install ducted extractor fans in wet areas and ask occupants to avoid drying clothes inside or using portable gas heaters. Encourage occupants to open windows, even if it is just for 10 minutes each day.
- If the ceilings are penetrated with older-style downlights, replace with new, tighter-sealing designs or with ceiling-mounted lights.
- Make air-leaky ceilings (such as older strip timber ceilings or acoustic tiles) more impermeable. This may be achieved by replacing with a stopped plasterboard ceiling. BRANZ recommends the installation of an air barrier behind tongue and groove ceilings.
- If the moisture is coming from a damp subfloor, take steps to make the subfloor space drier. Fix any leaking pipes, ensure there is sufficient subfloor ventilation and lay a polythene vapour barrier on the ground.

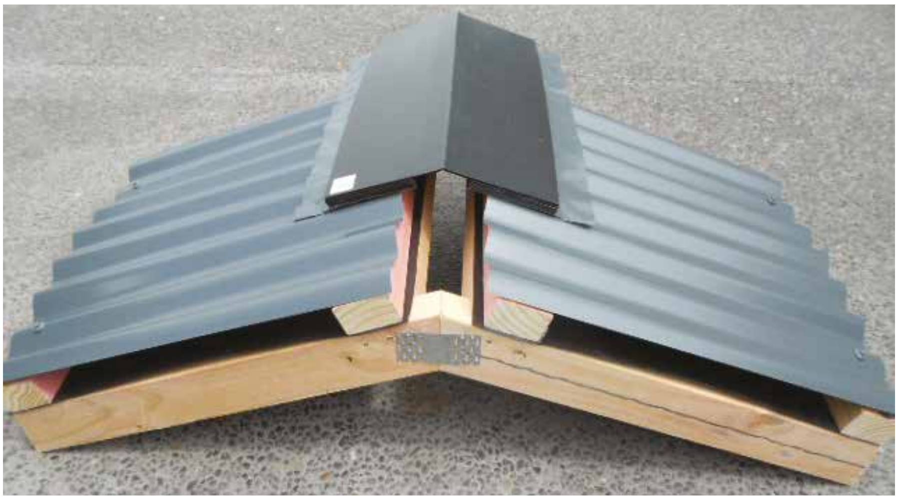
Roof space ventilation

Most houses do not have a problem with their roof spaces. Where there is a combination of risk factors, however, a designer should consider whether roof space ventilation is necessary. Factors include the following:

- The building design or specification means the roof space is likely to be airtight. Trough profiles, often necessary on low-pitch roofs, tend to give a more airtight fit than conventional corrugated profiles.
- The ceiling is unlikely to be an effective air barrier because of the ceiling type or the number of ceiling penetrations.
- Indoor moisture levels are likely to be high due to occupant behaviour. Construction moisture has been found to be the cause of roof space condensation as well.
- The house is located in a low-wind area, meaning less air exchange.

Passive ventilation elements are typically installed at the soffit/eaves and the ridge of a roof. Fresh air is usually drawn in at the eaves, while vents installed at the ridge act as an outlet. Careful detailing and installation is necessary to avoid problems with leaks and weathertightness.

Ventilation is especially important with skillion roofs – see Fact sheet 4 *Moisture and ventilation in skillion roofs* and BRANZ Bulletin 610 *Preventing moisture problems in timber-framed skillion roofs.*



Ridge vent.

Passive ventilation will provide a solution for the vast majority of houses. In rare cases, active ventilation with fans may be required.

In addition to managing moisture, roof ventilation can help to moderate extremes of temperature in the space, potentially extending the lifespan of roofing materials.

Designing roof space ventilation

No specific roof ventilation performance requirements are given in the New Zealand Building Code or in the referenced standards. Passive roof ventilation openings are mandatory or recommended in some other countries, however.

The size of the ventilation is often described as a ratio between the net free opening area of the vents to the area of insulated ceiling. While ratios ranging from 1:150 to 1:600 can be found, 1:300 seems to be a frequently specified fraction. To give a very simplified example of how this works, consider a 2-storey house with a 75 m^2 insulated ceiling area (the ceiling area of the lower storey doesn't count towards the insulated area). When the 1:300 ratio is applied, the result is a recommended total vent opening area of 2500 cm^2. This can be achieved with soffit and ridge vents.

Manufacturers often define products in terms of a net free opening area per unit length of installed product, helping designers to specify what is required.

Because the primary purpose of ventilating roofs is to remove moisture, the design and location in the roof should obviously allow for good airflow. Outlet vents, such as ridge vents, must only be installed in conjunction with inlet vents. Inlet vents should be dimensioned slightly larger than the outlets to ensure all makeup air comes from outside and is not drawn from inside the building.

In marine or geothermal environments, higher-grade metal fixtures are recommended around ventilation openings to reduce corrosion risk.

Homeowners should be advised to inspect roof spaces at least annually to watch for potential mould and moisture problems, especially in newer, more airtight homes.

More information

Fact sheet 2 *Testing the airtightness of residential roof spaces in three dwellings*

Fact sheet 3 *Air permeability of common New Zealand ceilings and ceiling penetrations*

Fact sheet 4 *Moisture and ventilation in skillion roofs*

Rupp, S., Plagmann, M. & Cox-Smith, I. (2018). *Airtightness of roof cavities*. BRANZ Study Report SR401. Judgeford, New Zealand: BRANZ Ltd.

BRANZ Bulletin 610 *Preventing moisture problems in timber-framed skillion roofs*

BRANZ Bulletin 630 *Roof space ventilation*