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Too much moisture in the roof

A recently renovated home had a problem with mould in the roof cavity. BRANZ found moisture from a poorly ventilated bathroom was passing through downlights into an airtight roof space. It's a lesson for others.

EXCESS MOISTURE can be a problem in roof spaces causing building material degradation, corrosion and mould growth. Moisture can accumulate in the roof space:

- from the outside - which is the least likely
- in the form of construction moisture that remains in materials after close-in - usually in the first 2 years
- from the living areas and bathrooms.

When the ceiling is not airtight

Moisture from the living area can easily migrate to the roof space if the ceiling is not airtight. If the roof space is cold enough, this moisture can then condense.

As part of a Building Research Levy-funded project, BRANZ was called by a builder to look at the roof space of an Auckland home where mould growth was evident. As the 1980s house was renovated 3 years ago, construction moisture shouldn't be a problem any more.

BRANZ has a methodology to measure roof and ceiling airtightness using two large blower-door fans. The measurements allow us to find out the expected air exchange between the roof and outdoors and between the roof and indoors via the ceiling. For more details on how this method works, watch out for BRANZ Study Report SR401 *Airtightness of roof cavities* (available later in the year).

Mould growth in the Auckland home's roof.

Roof airtight – no escape for moisture

The airtightness measurement revealed that this gable roof space was on the airtight side and would not allow enough air exchange for the moisture load it was exposed to.

The method allows us to calculate an effective leakage area - essentially the size of all openings in the roof envelope.

The ratio of this leakage area to the total ceiling area of the building is often used to characterise the sizing of roof ventilation. Some countries prescribe ventilation ratios, ➤

Air-permeable downlights were part of the cause.

such as 1:300 in certain parts of North America. In this case, the ventilation opening to ceiling area ratio only reaches about 60% of that benchmark.

Moisture getting through ceiling into roof

The ceiling, on the other hand, was not airtight. The airflow through the ceiling into the roof was estimated to be about 40 L/sec under normal operating conditions. This high flow rate was largely down to a high number of LED downlights that, due to their design, were very air permeable.

To identify the source of the roof moisture, temperature and humidity sensors were installed in the various rooms and the roof space itself. Of interest were particular rooms where high moisture was generated such as bathrooms, bedrooms and the kitchen.

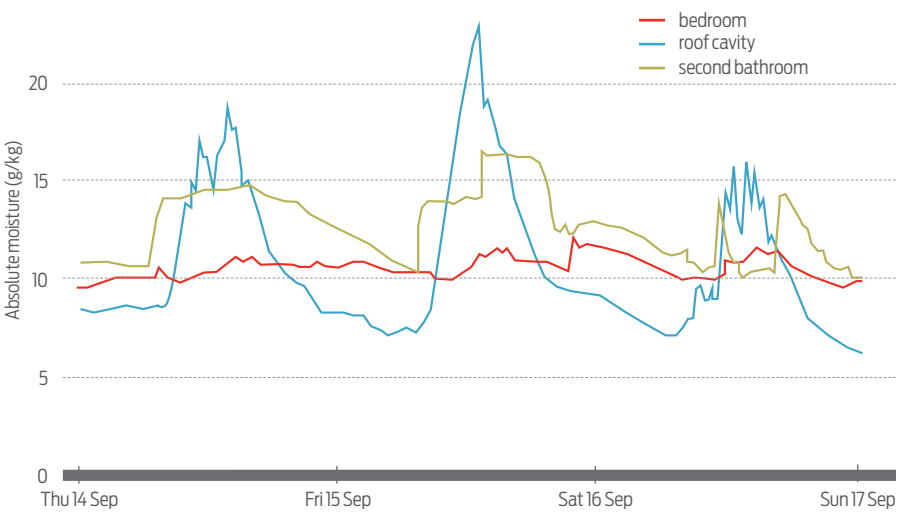

Figure 1: The absolute humidity (grams of water per kg of dry air) in the rooms and the roof space over 3 days.

Not enough ventilation in bathroom

Figure 1 shows the absolute humidity in the rooms and the roof space over the course of 3 days. The absolute humidity is independent of temperature, unlike the relative humidity, and shows when the moisture content of the air is increasing or decreasing. This allows us to identify sources and sinks of moisture.

It can be seen that the bathroom is a strong source of moisture over the whole day while the bedroom stays high but relatively constant. The moisture in the bathroom typically increased in the early morning, and a little later, the moisture level in the roof space followed suit.

This suggests that the bathroom was not being ventilated well enough and the moist air was passing through the downlights into the roof.

Advice to address these moisture issues

Overall, the house represents the perfect storm for roof moisture problems – a high internal moisture load, a ceiling that is not airtight and a roof that is not well ventilated. We have seen this moisture dynamic in a number of homes.

In most cases, the transport of moist air from the living area to the roof space is the source of moisture. The inadequate roof ventilation is then unable to cope with this moisture load, resulting in corrosion and mould inside the roof space.

If mould growth is observable on surfaces in the roof space, make sure the living area is well ventilated and does not show relative humidity over 65% over a prolonged period of time.

Check for air leakage paths into the roof space from the living area.

Adding roof ventilation will also make the roof space more resilient to moisture that gets transported to the roof, but there is a limit to what roof ventilation can do.