Roof space moisture

Recent BRANZ research has confirmed how moisture gets into roof spaces and highlighted the critical role ventilation has in removing it.

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BEFORE THE PUBLICATION of BRANZ Bulletin 302 in 1992, condensation problems in roofs were thought to be caused by diffusion driven by water vapour pressure differences.

Air movement key, not diffusion

Recent BRANZ research has confirmed that air movement from internal spaces into roof spaces is the predominant means of moisture transport. It's greater than moisture movement from diffusion by at least two orders of magnitude. So, why is air movement the predominant moisture transport agent?

Typically, air pressures within a roof space at night are lower than those within the building. This means that there will be a flow of air from inside spaces to the roof spaces through gaps or cracks in or around the ceiling lining or open downlights. If moisture is present in the space below, it will be carried into the colder roof space and potentially condense on colder surfaces.

Stopping internal airflow into roof space

The transport of air through the ceiling and other surfaces connected to a roof can be dealt with by:

- avoiding openings in the ceiling, particularly open downlights
- sealing penetrations, such as for wiring and lights
- installing an airtight lining, such as flush-stopped plasterboard
- installing an air barrier behind air-leaky linings such as T&G boarding
- ensuring spaces that have high moisture levels, such as kitchens and bathrooms, are well ventilated so that the moisture is removed before it can be transported into the roof spaces.

BRANZ research shows that controlling the relative humidity in the living quarters reduces the probability of roof moisture reaching high humidity levels by about half without the use of air barriers and vapour retarders.

Dealing with diffusion

As with air pressure, night-time vapour pressure is usually higher within building spaces than within a roof space.

Specifying vapour retarders, such as an oilborne coating, on the warm side of the building envelope for spaces with a high moisture load, such as kitchens and bathrooms, can be useful. This will prevent the moisture vapour transmission through lining materials and lower the risk of roof space moisture.

Ventilation important but ...

Ventilation of a roof space was discussed in *Ventilation dries attic space* (*Build* 148, pages 78–79). Calculations at BRANZ show ventilation of the roof space will prevent some condensation but not all. One reason is that cold outside air has very little moisture capacity so is of limited use in controlling condensation effectively, particularly during the night.

Some moist air will be removed by airflow through the roof, but because New Zealand's night-time outdoor air typically has a very high relative humidity, very little drying will occur. The cold night-time air introduced by ventilation can also be a source of condensation if, on clear nights, radiative cooling brings the temperature of the roof cladding below the dew point temperature. These conditions are reasonably frequent in parts of New Zealand.

Current practice uses natural roof ventilation

Measurements have shown that the airtightness of roof spaces varies widely depending on climate, local pressure moderated by wind exposure and so on.

Currently, roof ventilation is usually provided by uncontrolled natural ventilation around the roof cladding specified. For example, a roof cladding such as corrugate or trapezoid profiled steel, metal tiles or concrete tiles all allow uncontrolled ventilation of the roof space to occur.

The other option would be to specifically detail ridge vents, eaves vents or gable end vents.

However, too much ventilation may have unwanted side effects such as energy wastage.

Several critical design considerations

There is no New Zealand-specific rule of thumb or simple calculation to determine how much ventilation should be provided for a given roof design and location. During the building design process, critical parameters that need to be considered to achieve a well performing roof are the:

- outdoor climate and radiative cooling
- solar gain
- wind speed and site exposure
- ceiling construction and finishes
- indoor moisture conditions (this is dependent on occupant behaviour).

Some of these factors can be readily identified, but others need to be estimated for now. New BRANZ research projects will make information available on air transport through different ceilings types and the occupant behaviour to help the design process.

Problems using foreign codes or standards

It can be tempting to use design tools from other countries when looking for solutions to roof ventilation. However, there is no certainty that these will work under New Zealand conditions and building practices.

Often, other countries have different compliance frameworks from New Zealand. These may make inaccurate assumptions about certain critical aspects of the performance of the building component.

For example, the Canadian Building Code, which is often cited in this roof design context, has an airtightness requirement that we do not have here. A roof designed according to the Canadian Code without considering our Code and climate will probably fail. This is because the Canadian airtightness target for the living quarters and their ventilation cannot be met.

Needs to dry out

Condensation is not preventable under all circumstances. However, as long as the structure is allowed to return to its initial dry state over a period of time, the roof will manage the moisture load.