Moisture and ventilation in skillion roofs

Skillion roofs need carefully designed and installed ventilation to reduce the risk of moisture-related problems. BRANZ research provides guidance around the ventilation of these roofs.

IN SKILLION ROOFS, the roof cladding and ceiling run parallel, typically within 300 mm of each other. The roof space is generally inaccessible, with little natural ventilation.

The small roof space can accelerate problems with moisture. Consider a simplified comparison: two roofs – a skillion roof with an area of 45 m^2 and a roof space air volume of 3 m^3 and a gable roof with the same area but with a ridge height of 1.4 m. Further assuming an air-leaky ceiling and an airflow upwards of approximately 5 litres/second, the skillion roof space would fill from the room below in 10 minutes. The gable roof would take 1 hour and 40 minutes to fill, however, allowing time to dilute the moist air even if outdoor air infiltration is slow.

Skillion roofs should include ventilation openings to effectively manage roof moisture.

Moist air that is not removed by air leakage stays in the roof space – either in the roof space air or in the building materials. Where roofing temperatures fall below the dew point, the moist air can condense to form water. It may wet insulation or be absorbed by framing or roof underlay. Where it accumulates in the roof space it can support the growth of mould.

Moisture may remain in the roof space immediately after construction if the framing timber is not sufficiently dry (preferably with less than the maximum permitted 20% moisture content) when the ceiling is installed.

A more widespread problem is likely to be moisture moving into skillion roofs from living spaces through gaps and openings in the ceiling, driven by wind-generated air pressure differences or because room air is warmer.

Skillion roof with ventilation openings under the eaves

Ceiling linings must resist airflow to the roof space. Ceilings that are relatively permeable such as tongue and groove boarding must be sealed by an air barrier – a breather-type underlay. A flexible wall underlay meeting the air barrier requirements of Table 23 of E2/AS1 is suitable provided joints are taped.

Penetrations should be avoided where possible. Recessed downlights should be IC or IC-F rated with no gaps. Some LED downlights are fitted with a rubber gasket, which essentially provides a sealed system.

Ventilation of skillion roof spaces

Research shows that even limited air movement in a skillion roof space can remove small amounts of vapour. Natural ventilation is limited for claddings that are practically airtight when installed, however, such as:

- long-run trough or tray section profiled metal
- continuous membrane roofing
- asphalt shingles.

Ventilation channels should be designed into a skillion roof to reduce the risk of condensation problems (Figure 1). Careful

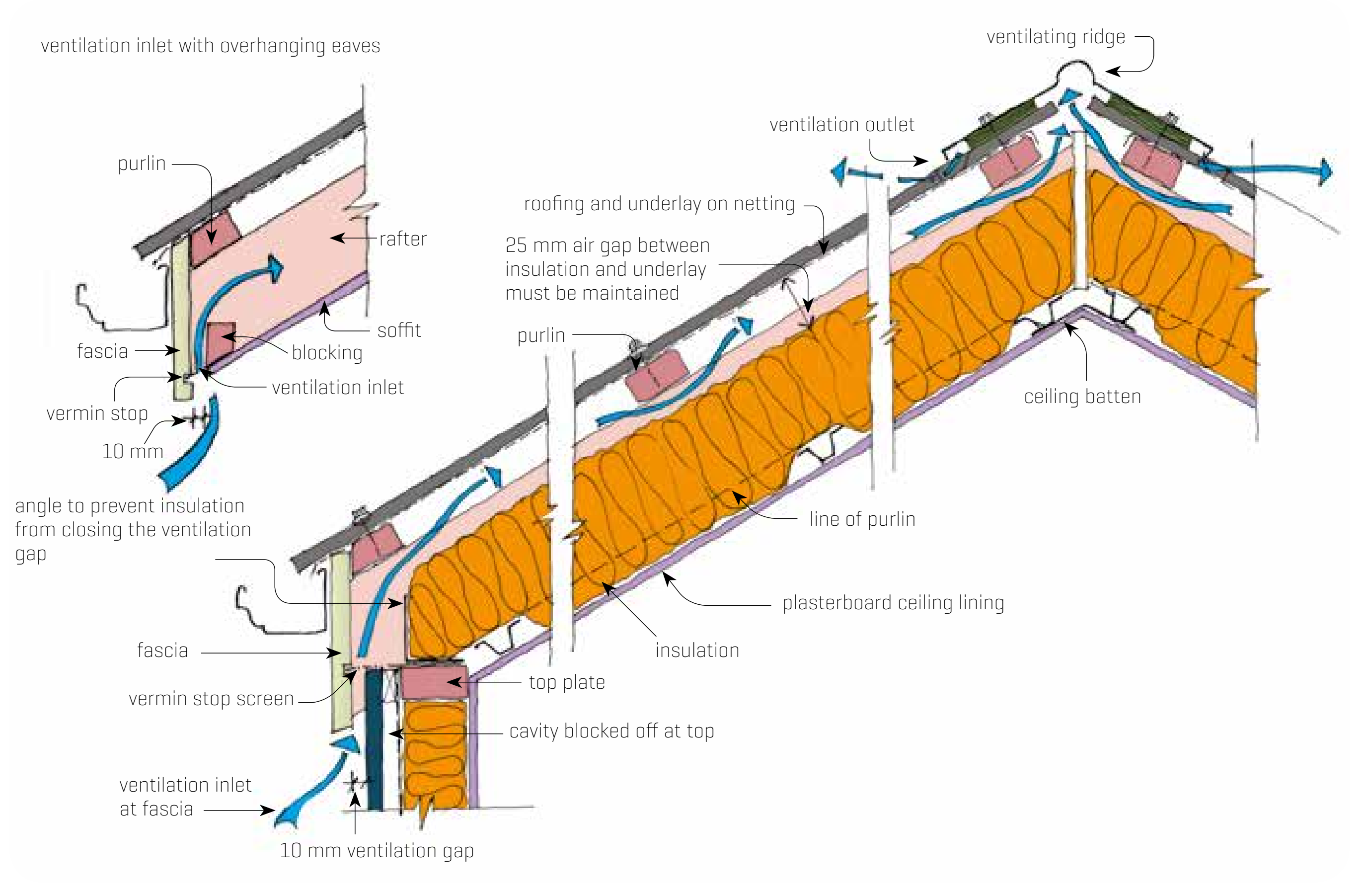

Figure 1. Designed ventilation path through a skillion roof space.

design and construction is needed to ensure the ventilation pathways can function fully and do not become blocked.

One potential problem spot is the zone where there is no air movement. Tests have found that low air velocity exists in the corners between the purlins and the roof underlay. Any moisture here could be trapped. To avoid this, airflow has to get between the roof underlay and the purlin so it can remove any potentially moist air.

Adding ventilating battens – castellated timber battens or uPVC battens with a honey-comb-type structure – can improve airflow (Figure 2). The battens should be installed between the underlay and the purlin. Adding this gap for airflow above the purlin almost doubles the airflow cross-section at the purlins. This reduces both the potential for air trapped near the cold roof cladding and airflow resistance inside the roof.

Some manufacturers have specific requirements around ventilation when their products are used. These requirements should be studied and followed.

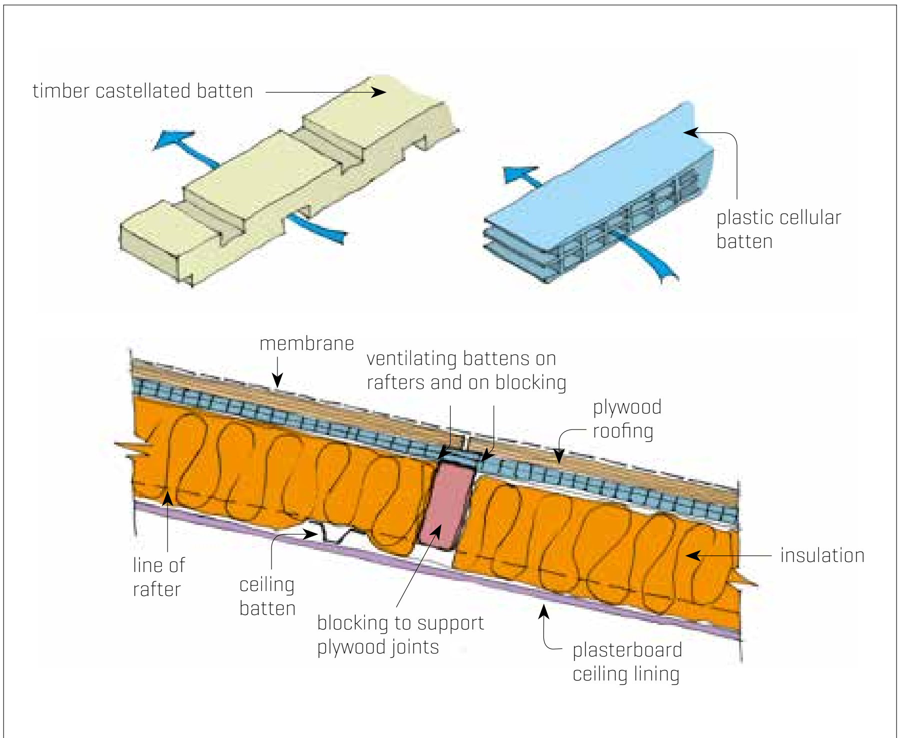

Figure 2. Construction of a skillion roof with plywood and membrane finish to allow air movement between rafters.

Placement of ventilation openings

In high wind zones, the placement of vents in metal and tile-clad skillion roofs might not be critical. It is different for low wind zones, however. BRANZ research indicates the best places for effective ventilation openings in these zones.

Airflow simulations were carried out for a profiled metal skillion roof, with and without eaves. The results were quite different:

- In the roof with eaves, the highest air pressure (and therefore the best place for roof ventilation) was underneath the eaves. Ventilation openings can be placed here without affecting weathertightness or roof insulation.
- In the roof without eaves, the highest air pressure was below the roof structure near the top plate of the wall.

Ventilation is not driven by pressure but by differences in pressure around the building envelope. The potential effectiveness of various locations for ventilation openings can be assessed by looking at the pressure differences around the building.

For roofs with eaves, the leeward side has almost even, low negative pressures while the windward side shows pressure gradients going from positive at the wall to negative pressures near the rain gutter.

Figure 3 shows the locations of different areas of pressure:

- Point 1, just underneath the roof cladding, is near a negative pressure location
- Point 2, underneath the eave, is at a positive pressure location
- Point 3, a leeward location on the other side of the roof, has low negative pressure

For vents located at points 1 and 3, the airflow through the roof would be down the roof slope from point 3 on the leeward side to point 1 on the windward side.

For vents at points 2 and 3 the airflow would be up the roof slope.

The pressure differences that drive the airflow for a vent location at the eaves (point 2) are almost twice as much as those for a vent location underneath the roof cladding (point 1).

This pressure gradient is driven by the airflow separation that occurs when the wind hits the edge of the roof.

The article 'Roof ventilation' in *Build* 157 shows a worked example of the principles used to estimate the minimum number of ventilation openings required when there is little wind.

More information

Fact sheet 1 *Roof space ventilation in New Zealand houses*

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*

Plagmann, M. (2017). Roof ventilation. *Build* 157, 57–58.

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

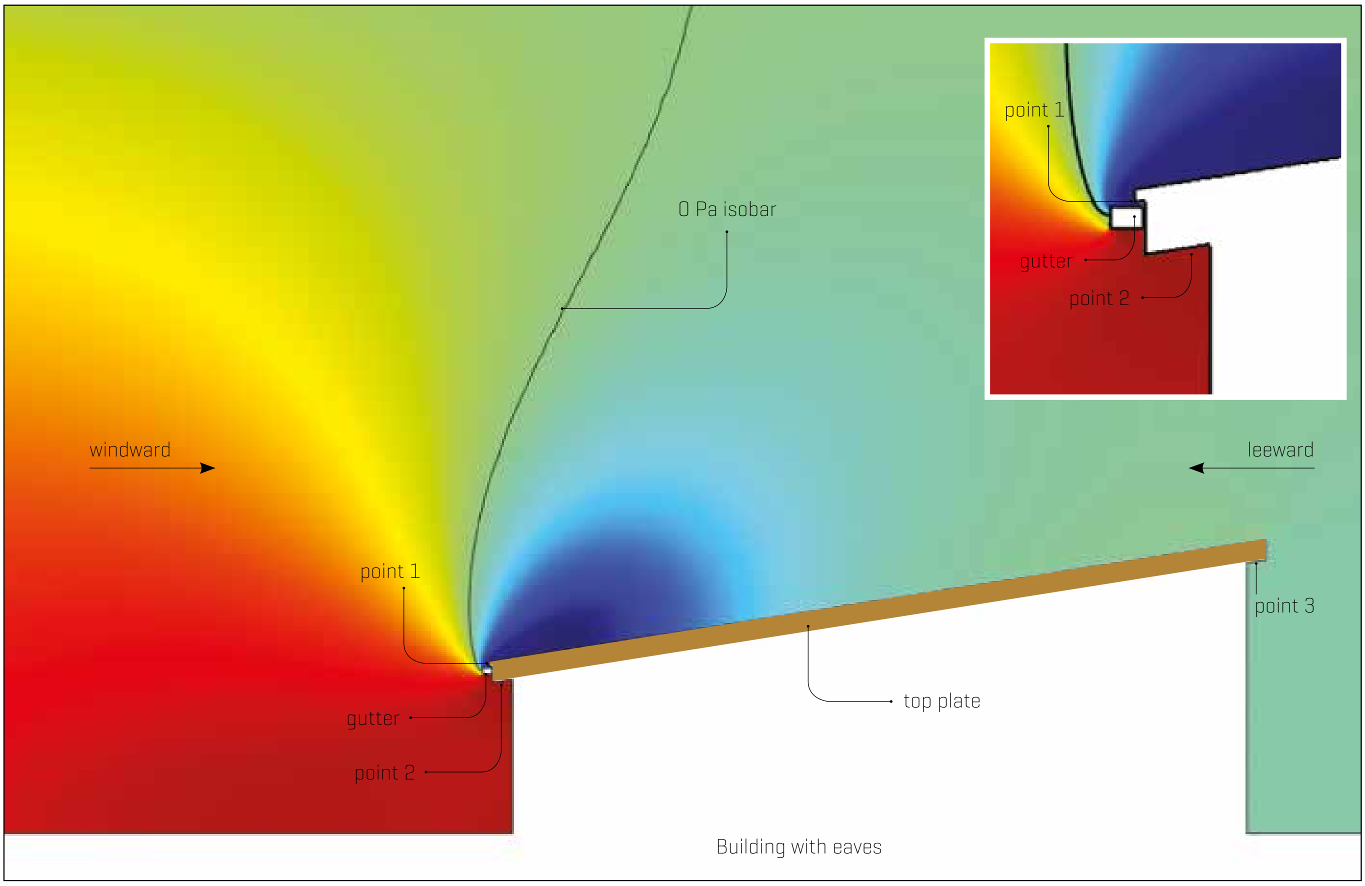

Figure 3. Air pressures on a monopitch skillion roof with eaves. Dark red is high positive pressure, dark blue is high negative pressure.