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Wind and floor insulation

Ventilation is required to reduce moisture levels, but can too much subfloor ventilation reduce the effectiveness of underfloor insulation? BRANZ set out to find the answer.

THE BRANZ SUBFLOORS project has been investigating the condition of spaces under suspended timber floors. The primary focus has been on the impact of high humidity levels on the moisture content of framing and the corrosion of fixings.

Does wind affect insulation?

One possible solution to elevated moisture levels is to increase subfloor ventilation, but will this impact on the thermal performance of the underfloor insulation?

To answer this question, BRANZ set out to understand the relationship between thermal resistance and wind speed for both foils and bulk insulation. As part of this, the average performance over an entire winter was also monitored in a relatively open subfloor.

Move from foil to bulk insulation

After the Building Code required insulation in the 1970s, most suspended timber floors were insulated with draped perforated foil.

More recently, concerns about the performance and safety of foil insulation in subfloors has seen the growth of bulk insulation materials including expanded polystyrene, glasswool and fibrous polyester.

To provide adequate thermal performance, draped foil needs the surrounding air to be as still as possible. Even very light wind flows can severely undermine its ability to insulate.

Bulk insulation materials, on the other hand, have a graduated reduction in performance as the wind speed increases.

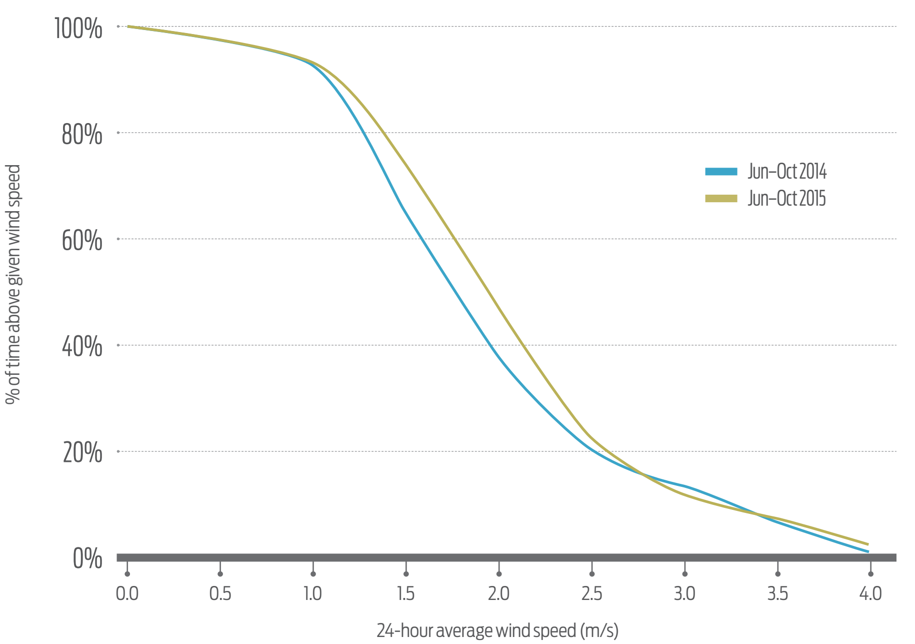

Figure 1: Ground level wind speeds under the test house.

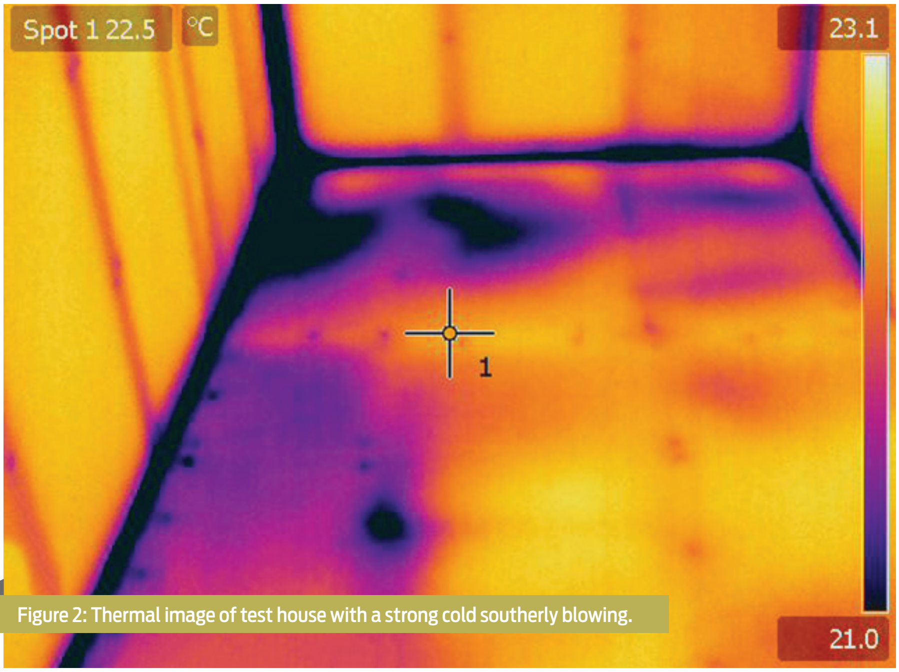

Figure 2: Thermal image of test house with a strong cold southerly blowing.

Changes to subfloor ventilation over time

Over the last 40 years, how subfloor spaces are enclosed and ventilated has also changed. Solid concrete foundation walls with embedded vents have been largely replaced by timber slats or sheet cladding with vents.

Flooring has become more airtight as tongue and groove boards have been replaced by sheet materials. Suspended timber floors are now more likely to be used on steep sites than flat ones, so the typical wind exposure has generally increased.

Materials monitored in test house

BRANZ monitored the thermal resistance of a representative selection of underfloor insulation products for a 2-year period beginning in the winter of 2014 in the BRANZ subfloor test house at Judgeford.

The floor joists of the test house are aligned with the prevailing northwesterly winds. Wind velocity and direction were measured both at ground level under the test house and at a height of 10 m at the site weather station around 20 m away.

Bring on the wind

The wind speed distributions for the 2014 and 2015 winters are very similar (see Figure 1), with most daily average wind speeds in the range 1 to 3 m/s.

In both years, the prevailing wind direction is northerly, but there are also relatively frequent southeasterlies in the middle of winter. The strongest and most sustained winds (above 2.5 m/s) tended to come from the northerly direction.

Since in situ measurement of thermal resistance requires a sufficiently high temperature difference through the floor, the data analysis was restricted to the cooler months from June to October.

Thermal image shows where wind penetrated

The test house subfloor orientation and location in the greater Wellington region subjected the insulation products to significantly more wind wash than many suspended timber floors in New Zealand. The thermal image taken when a strong cold southerly was blowing (see Figure 2) represents a worst-case scenario compared to the average wind speed over the winter period.

The effect of air penetrating into the end of the insulation closest to the perimeter joist is visible in Figure 2. The wind also penetrated into a small gap between the top surface of the insulation and the bottom face of the flooring.

Wind speeds above 1 m/s have an impact

Thermal resistance was plotted against wind speed for 5 months of data (see Figures 3 and 4). These demonstrate the impact of wind wash on two polyester-based products. The R-values are system values and so are typically higher than the actual R-value of the insulation material alone.

A short-term burst of very strong wind on medium and high-density fibrous products, and rigid foam (EPS) had a:

- temporary impact on the heat flow through or around the materials
- negligible impact on the longer-term average R-value (it was below the resolution of the measurements).

When average wind velocities were below 1 m/s, no significant impact on thermal resistance was detected, even for low-density fibrous products.

Wind speeds above 1 m/s had a roughly linear impact on the still air R-value for medium and low-density fibrous products:

- Data for the low-density glasswool reveals a 9% decrease in R-value for a 1 m/s increase in average wind speed.
- The value for two low-density polyester products was similarly 12% for every 1 m/s increase.

Solution for wind wash in exposed subfloors

This means wind generally has an insignificant effect on insulation where a closed subfloor has a Building Code level of ventilation openings (3,500 mm^2/m^2).

Where the subfloor insulation is exposed, good thermal design can be achieved by increasing the R-value of the insulation material by approximately 25% to counter the wind-wash impact. This assumes an average wind speed of 2 m/s under the floor.

It would mean that an R1.9 low-density fibrous insulant could be assumed to perform as effectively as an R1.5 medium or high-density insulant in an exposed subfloor.

For more The BRANZ subfloors study report will contain more detail. It will be available from www.branz.co.nz in April.

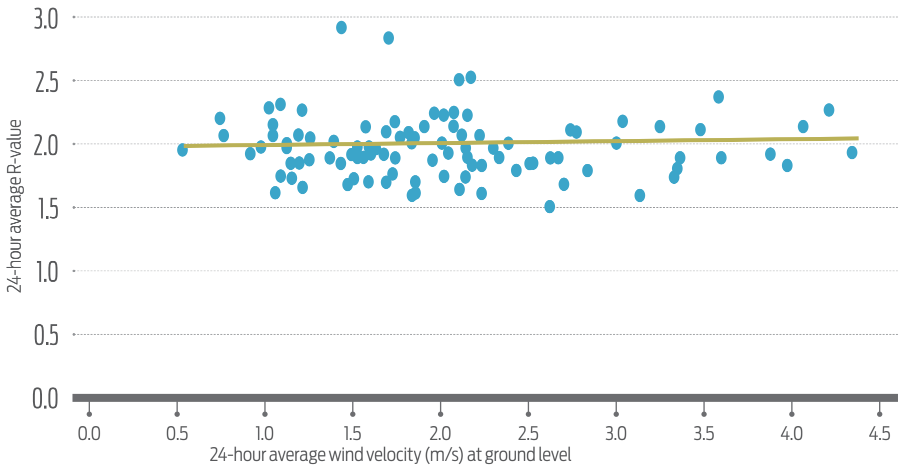

Figure 3: Thermal resistance of high-density polyester segment.

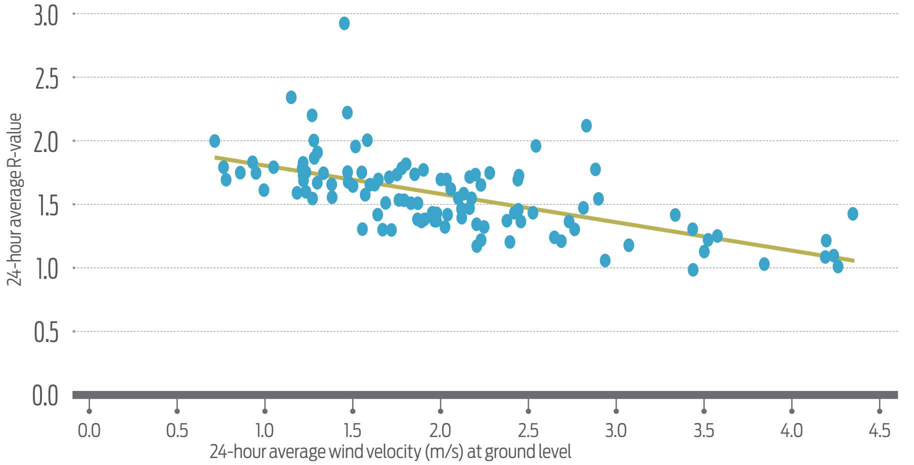

Figure 4: Thermal resistance of low-density polyester blanket.