Modelling moist subfloors

With continuing analysis at BRANZ since the article *Ventilation and subfloors* in *Build* 149, we're now able to shine more light on moisture accumulation in subfloor spaces.

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THE VENTILATION RATE of the BRANZ WAVE (Weathertightness, Air quality and Ventilation Engineering) research building subfloor was recently monitored for several weeks using a tracer gas. This was done to calibrate computer models of airflows in and out of the space as well as the moisture transport in the air, building materials and ground.

Getting an accurate picture of the airflows in a building, whether it is a room, behind a cladding or the subfloor space, can be difficult. The number and nature of holes and cracks in the enclosure are very difficult to determine. For the interior, an estimate can be made from the results of a blower door test, but this cannot account for wind exposure or other factors.

Tracers in relatively airtight subfloor

For a better result, this BRANZ research configured the subfloor into a relatively airtight state, with total leakage openings equivalent to a single vent of around 200 mm diameter. This is less than the requirement in NZS 3604:2011 *Timber-framed buildings*.

A tracer gas was dosed at a constant rate into the space and its concentration change recorded over time. Tracer gas techniques are a powerful way of investigating air movement in buildings. However, the cost and equipment required limits their use to research settings.

Ventilation rate calculations were then made using these concentrations, the tracer gas dosing rate and the air temperatures in the subfloor and outdoors.

High air change rate needed in subfloor

The measured ventilation rate looks relatively high, with a mean of 11.5 air changes per hour at atmospheric pressure (see Figure 1).

However, this is distinct from a blower door test, which is undertaken at an elevated pressure difference of 50 Pascal. ➤

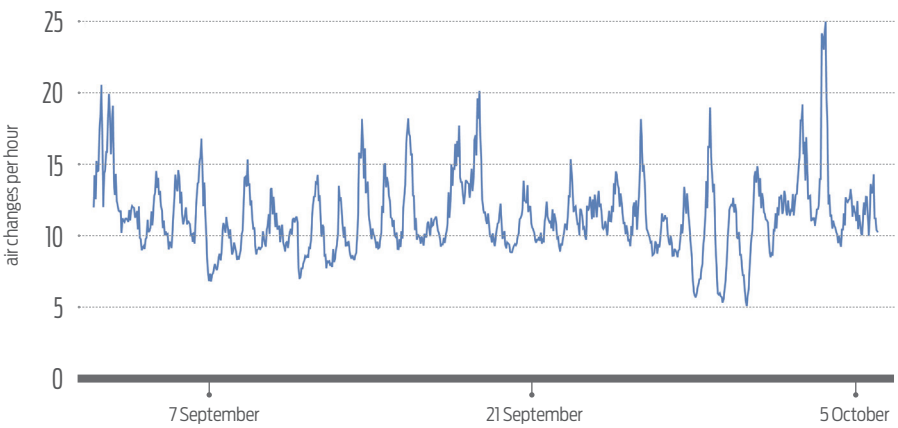

Figure 1: BRANZ research building subfloor ventilation rates over 1 month.

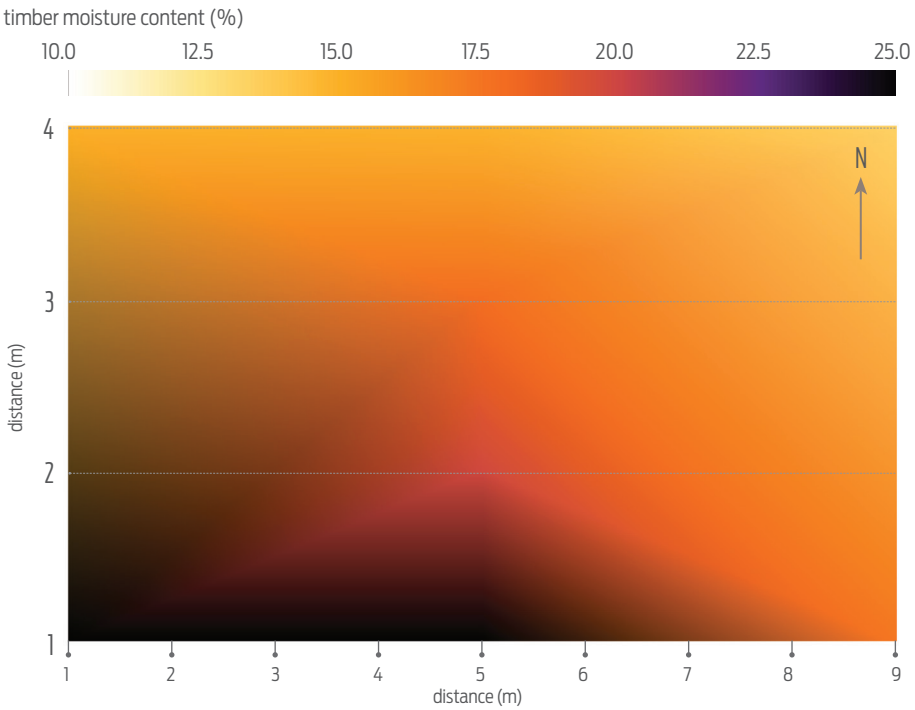

Figure 2: Heatmap of framing moisture content in BRANZ research building subfloor when vents closed.

The measured ventilation is much greater than what is typically experienced in the living space above. In living spaces, even 1 air change per hour can result in overventilation and energy loss becoming an issue.

Subfloors are different from the living area because of the large, consistent moisture source and smaller air volume. Even though the air change rate seems relatively high, the results in *Ventilation and subfloors* in *Build* 149 show that the test vent opening is not enough to deal with evaporation from subfloor soils.

Results informing models

These measurements give important information that is being used in the heat and moisture tool WUFI and the BRANZ nodal model of this building to establish the evaporation rate from the soil.

Once this is finalised, the models will be able to be expanded to include extra vents.

Wind wash and insulation performance

In addition to the moisture work, there is research into the effects of wind wash on the performance of subfloor insulation.

Results so far indicate that the effect is dependent on the density of the insulation product. Simply adding slightly more insulation or using a denser product can limit any reduction in performance. This will be the focus of a future *Build* article.

Uneven patterns of moisture

The rapid accumulation of moisture when the subfloor in the research building was sealed (shown in *Build* 149) had a very interesting effect. More detail is shown in a heatmap or contour plot of the framing moisture contents in the subfloor when moisture contents peaked before the vents were opened (see Figure 2).

On the southern side of the building, framing timbers reached fibre saturation, though the effect was not uniform. Moisture contents were highest on the southern side and steadily lowered further away from this point - it radiated in a circular pattern (see Figure 2).

This phenomenon was related to the temperature of the rooms above. The southern side had much less solar exposure, resulting in a lower surface temperature of the flooring.

Thorough subfloor check needed

The implication for industry is that a simple spot check crawling under a building and looking at the condition of framing timbers will not necessarily give a complete picture. There is the need to be more thorough and look over the entire subfloor space.

More guidance coming

With such a dramatic accumulation of moisture in a well exposed, rectangular subfloor, it's clear that moisture problems in more confined subfloors are likely to be worse. When the floorplan is complex or building additions have blocked vents off, it may be difficult to ventilate well.

Guidance will be available at the end of the BRANZ subfloor project to help in these situations.