Beware insulation tucks, folds and gaps

It's widely known that tucks, folds and gaps in insulation reduces its thermal performance, so correct installation is important. Now, BRANZ is aiming to quantify exactly what impact poor installation has on a house's performance.

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NZS 4246:2006 *Energy efficiency – Installing insulation in residential buildings* is primarily intended to provide guidance to thermal insulation installers but it also acts as a framework for building inspectors to assess installations.

The standard specifies that thermal insulation must be installed without tucks, folds or gaps.

Unfortunately, even when an installer has been diligent about cutting insulation to the correct size for the frame spaces and installing it with care, other contractors such as plumbers, electricians or HVAC installers sometimes need to temporarily remove insulation and replace it after they finish.

A Building Research Levy-funded project is attempting to answer the question of what impact improper insulation installation has on the overall thermal performance of the building envelope.

Watch the tricky spots

To help answer this question, BRANZ has been coordinating with building inspectors from three councils in the greater Wellington region to undertake photographic surveys. These were done at the time inspectors carried out pre-lining inspections of houses under construction or renovation.

From this, it has been found that, usually, at least 90% of the installation is consistent with the standard, but inspectors suggest remedial work following the prelining inspection is usually required to achieve this.

Ceiling insulation gaps are the most common fault (see Figure 1). There are, inevitably, also a few areas where the insulation should be installed more carefully, including:

- the small areas between the blocking spacing the wall studs apart
- areas where small pieces of leftover insulation are combined to fill a frame space (see Figure 2)
- around water pipes and electrical wiring (see Figure 3).

A few examples of problems

At first glance, some installations appear to comply with the standard, but a careful inspection reveals issues.

STRETCHING MATERIAL TOO FAR

Sometimes, only just enough packs of insulation are supplied, which puts pressure on the installers to use as much as possible.

In Figure 2, this happened due to the relatively high cost and large volume R2.8 insulation product being used.

Ironically the high R-value materials are much easier to cut precisely and install than the lower R-value ones, which are more floppy to handle.

TUCKS AND GAPS

In Figure 4, nearly all the frame spaces have at least one edge of the insulation tucked.

There is also a significant gap between the insulation and the top plate in one of the top centre frame spaces.

This might seem pedantic, but similar plain walls were found with insulation perfectly installed with no tucks or gaps – even one installed by a very enthusiastic and proud apprentice on his first day on the job.

Given the simple and regular frame layout, there should be no excuse for not getting it perfect.

Figure 1: Gaps in ceiling insulation is the most common fault.

Figure 2: Small pieces of leftover insulation fill a frame space.

Figure 3: Inadequate supervision resulted in this poor installation around electrical wiring.

Figure 4: This installation looks OK, but nearly all the frame spaces have at least one edge of tucked insulation.

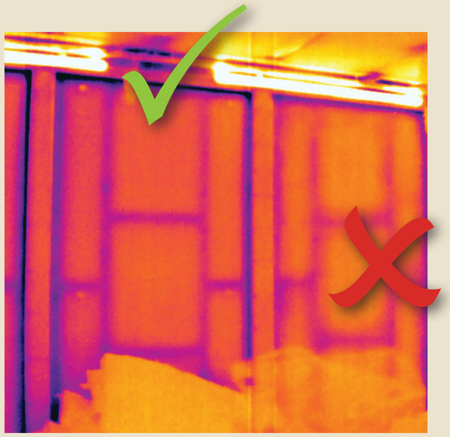

Figure 5: Thermal image of two panels in BRANZ research building. The left panel has no tucks in the insulation, the right has tucks.

EXTRA CARE NEEDED USING POLES

Poorly installed ceiling insulation often results from the new method of using poles to push insulation into place from below, rather than the traditional method of installing from above after the ceiling lining is in place. The pole method was introduced after polyester and wool insulation became available in roll form but segmented products still require the follow-up use of a ladder to fit the material well.

Ceiling insulation often has an air space between the ceiling and the underside of the insulation, so gaps around the edges of the insulation are much more detrimental than they are around wall insulation that completely fills the space between the cladding and lining. Convective heat transfer is able to carry heat away from the entire back surface of ceiling lining.

Follow-up to assess installations thermal performance

During winter, BRANZ staff will make follow-up visits to the same now-completed houses armed with a thermal imaging camera. The aim is to calibrate the thermal imaging camera so it can be used for both qualitative and semi-quantitative assessment of insulation installation quality.

Where possible 600 × 600 × 10 mm thick heat flux transducer panels will be temporarily installed against the interior linings in areas where thermal defects have been identified.

The transducers can measure the instantaneous heat flow travelling through the building enclosure at that point.

By simultaneously measuring both the interior and exterior air temperatures, the average thermal resistance can be estimated at that point and the results from areas without defects compared.

In principle, the measured thermal resistance areas that are free of thermal defects should be the same as what is calculated based on the known R-value of the insulation material and the amount of framing.

Equipment testing shows performance

To test the heat flux transducers, several were installed on the walls of a BRANZ research building. After measuring the R-value with the transducers, the linings of some of the walls were removed and the insulation inspected.

The originally installed insulation in one wall had tucks on most edges, so the insulation was removed, cut down to the correct size, then reinstalled without tucks and the R-value measured again.

With tucks, an R2.2 insulation product was performing as if it was an R2.0 product. Removing the tucks increased the performance of the insulation to its intended R2.2.

Overall, when the framing, cladding, and lining are taken into account, the 10% reduction in the R-value of the insulation material resulted in a 5% reduction in the R-value of the wall panel.

Figure 5 shows a thermal image of two of the wall panels. The one on the left has had the tucks in the insulation removed while the one on the right is the panel before the tucks were removed.

When there are no tucks, the framing is in sharp contrast to the insulation, but when tucks are present, the thermal signature of the framing is smeared.