build right

by Malcolm Cunningham,
BRANZ Principal Scientist

Condensation and thermal bridges

Although steel framing in domestic construction has only a small market share, there are signs it may be on the increase. Since steel is a good conductor, builders need to be aware of potential pitfalls, such as thermal bridges and condensation.

You only need to think of steamy windows on a cold day to realise how easy it is for condensation to form on a cold surface. The warm moist air on the inside hits the cold glass, releasing its moisture.

A thermal bridge exists wherever there is a high heat conductance path. In buildings, a steel framing member can act as a bridge, allowing heat to move from a warm interior, through the wall lining to the external cladding and outside, effectively bypassing the insulation.

Thermal bridges cause condensation

This means the temperature of the indoor side of the bridge will be closer to the outside temperature. On cold days this will cool the wall lining *along the bridge*. If this temperature is well below the dewpoint of the indoor air, moisture will condense on the lining, as shown in Figure 1.

If the steel framing touches the external cladding but not the internal lining, i.e. it is buffered from the inside, condensation can form instead on the steel in the wall.

Walls or roofs that have thermal bridges where condensation may occur on the internal linings will not comply with clause E3 *Internal moisture* of the New Zealand Building Code. The Acceptable Solution E3/AS1 requires thermal breaks when steel studs are used in wall construction.

Thermal bridges degrade R-values

Condensation is not the only potential problem with thermal bridges – the R-values can be seriously degraded.

Figure 2 shows the improvement in R-value if thermal breaks are used. With no thermal break (shown as 'none' in the graph), there is a possible 30% loss in R-value. Since R1.5 is the minimum required for walls in Climate Zones 1 and 2, this may mean a building fails to meet the code requirements.

What are thermal breaks?

Thermal breaks are insulating materials placed on the *cold* side of a thermal bridge (see Figure 3) so that

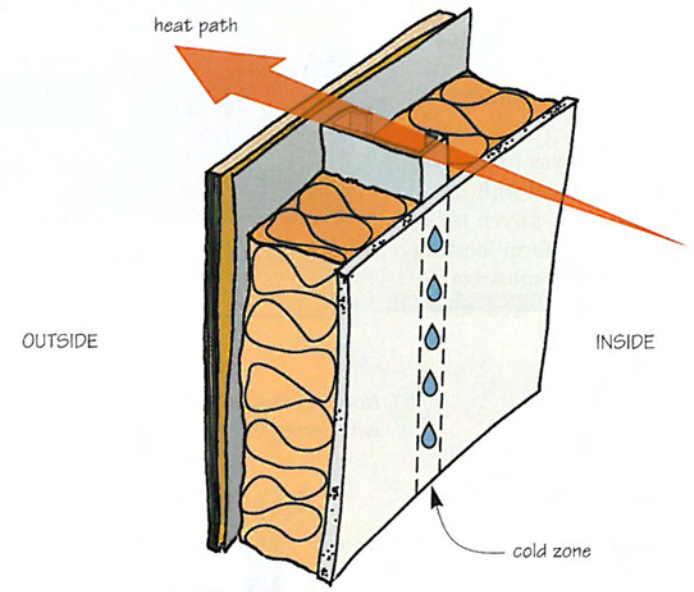

Figure 1: A steel stud wall with a thermal bridge creates a heat path that can cause condensation on internal linings.

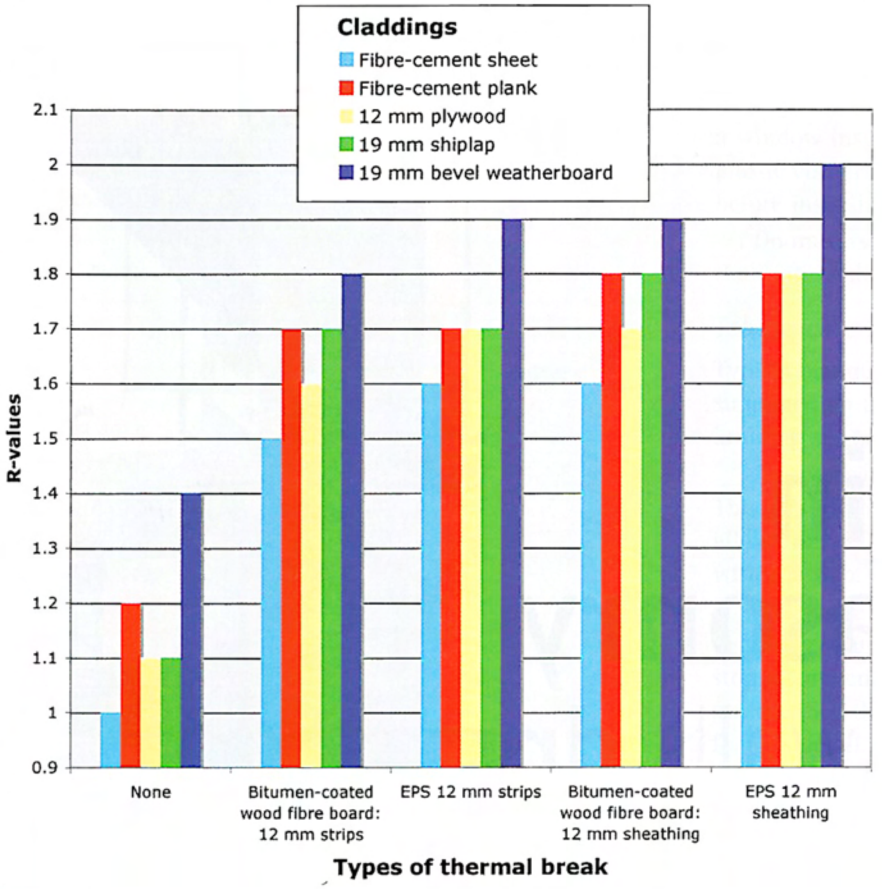

Figure 2: The effectiveness of thermal breaks can be seen in the R-values of a steel-frame wall with a range of claddings. (The wall has galvanised steel studs at 600 mm centres filled with R1.8 insulation.)

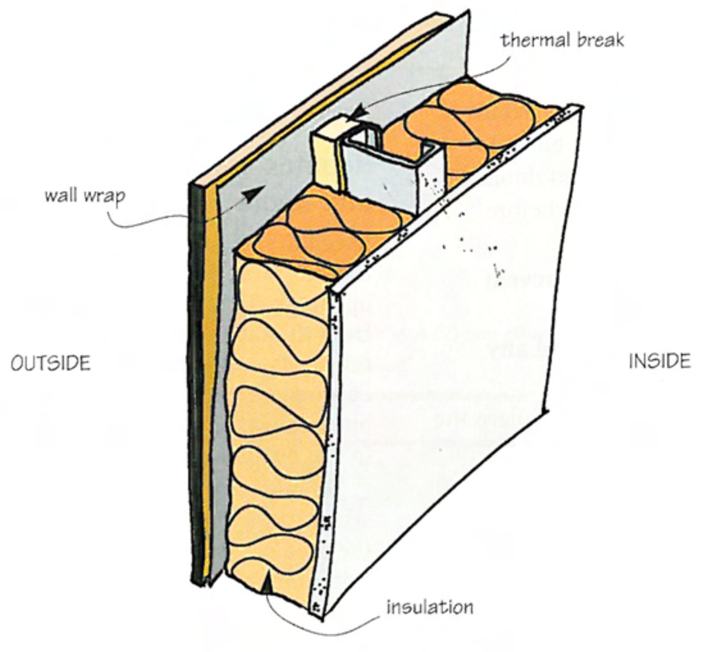

Figure 3: Typical wall construction with thermal break.

heat passing across the bridge meets a high thermal resistance barrier. Such barriers can either be strips of material across the width of the members where they meet the cladding, or sheathing behind the cladding. The aim is to keep as much of the structure as warm as possible, thus avoiding excessive heat loss and condensation.

The breaks should be installed on the outside of all steel exterior wall framing, including all dwangs and girts that have cladding fixed to them. If the floor is steel framed, breaks should also be used wherever the cladding is fixed to the floor members.

Insulation in a ceiling space with steel framing should be carried over ceiling joists, not just placed between them. Otherwise, the framing acts as a thermal bridge between the indoor space and the ceiling space.

What materials can be used?

The material and its thickness must have an R-value greater than 0.2 m^2 °C/W. It must support the exterior cladding, so needs to be non-compressible. Materials include 12 mm low-density wood fibreboard (softboard), 10 mm or extra high-density expanded polystyrene (EPS), or 10.5 mm bitumen-coated wood fibreboard. ›‹

What is the dew point?

The key to managing condensation within a building is understanding dew point.

When warm, moist air passes over a cooler surface, condensation can form. Condensation is the collection of moisture on a surface at or below the dew point. The dew point is the temperature air must fall to for saturation to occur. If a building material/component has a temperature *below the dew point*, condensation will accumulate on that material.