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Don't be cool about warm roofs

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While they may be more expensive to install, the popularity of warm roofs is growing as they are more thermally efficient, resulting in lower energy costs.

THE TRADITIONAL METHOD of constructing a low-slope, membrane roof is to install insulation between the rafters, leaving an air space between the insulation and the roof deck above (see Figure 1). This roof construction, called a cold roof, does have some disadvantages:

- Ventilation of the ceiling space is required as there is a risk of condensation forming on the underside of the roof deck, which may result in the insulation becoming wet and losing effectiveness where moist air can migrate into the roof space.
- The rafters can provide a continuous path or thermal bridge for heat movement from the interior to the exterior of the building.

What is a warm roof?

Warm roof construction is where rigid board insulation is placed over the roof deck and the waterproof membrane is laid over the insulation (see Figure 2). This means that the insulation is on the outside of the building envelope and the roof structure and ceiling space are at a similar temperature to the building interior.

Advantages and benefits

The advantages of warm roof construction:

- Thermal bridging is largely eliminated as the insulation is continuous over the whole roof structure.
- The need for roof space ventilation is eliminated or reduced. The ceiling space is on the warm side of the insulation. The dew point temperature (the temperature at which water vapour in the air condenses as water) is on ➤

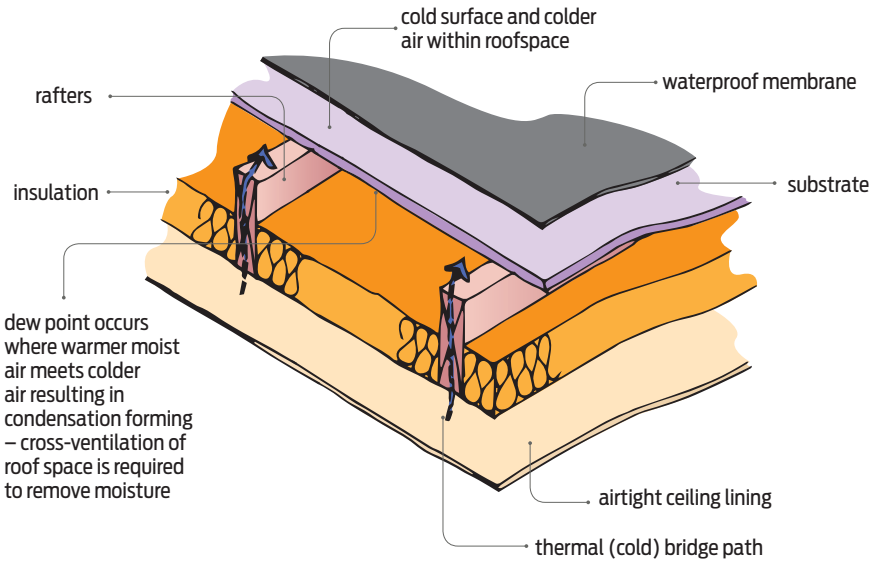

Figure 1 **Cold roof construction.**

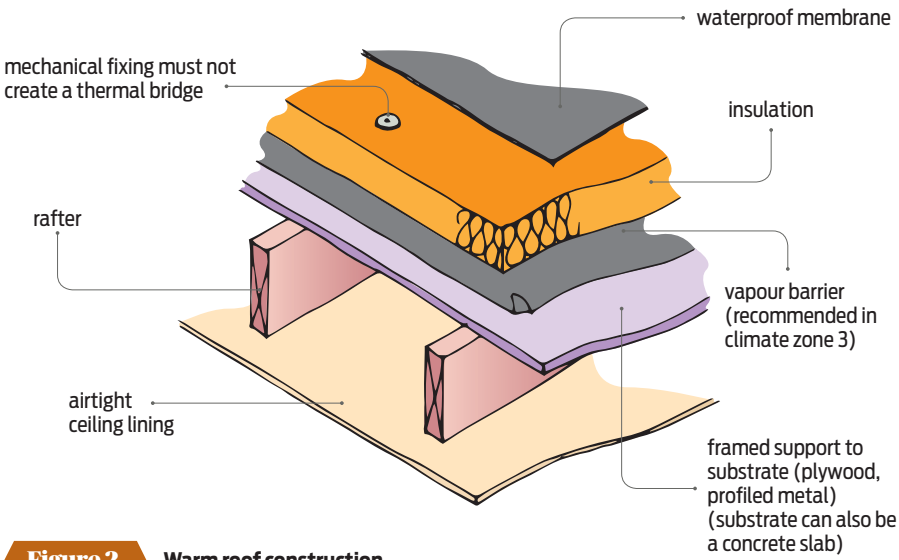

Figure 2 **Warm roof construction.**

the exterior side of the insulation, so condensation is unlikely to occur.

Warm roofs have significant benefits over cold roofs because:

- energy efficiency is improved
- heating and ventilation costs are reduced.

Statutory requirements

There are no specific New Zealand standards for warm roofs. However, a warm roof must meet the requirements of the following New Zealand Building Code clauses:

- B1 *Structure* requires that the design must be able to support the dead and live loads imposed by the roof.
- B2 *Durability* requires that the materials must provide a minimum 15-year durability.
- C1 *Protection from fire* is applicable where 'foamed plastic' insulation is used.
- E2 *External moisture* deals with the roof's ability to shed precipitated moisture.
- H1 *Energy efficiency* sets out the energy efficiency requirements of the roof.

Installation facts

Warm roof construction requires a continuous substrate, typically 17.5 mm minimum plywood or profiled sheet metal, to support the rigid board insulation. The insulation is laid over the substrate, and the roof membrane is then laid over the insulation.

A vapour barrier may be installed between the insulation and the substrate if desired. It is recommended in climate zone 3 due to lower average annual ambient temperatures.

Insulation options

Insulation for warm roofs generally consists of either polyurethane (PUR) or polyisocyuranate (PIR) rigid foam boards at least 75 mm thick. Advantages of PUR and PIR include that they:

- are excellent insulators
- have a closed-cell structure with high resistance to moisture absorption
- are self-extinguishing in fire and do not melt
- have excellent durability
- have low environmental impact
- have high acoustic absorption
- have high compressive strength
- can be faced with different materials to provide compatibility with different membrane types.

The insulation may be mechanically fixed or glued. Mechanically fixed systems must not create thermal bridges through the fixings.

Alternatively, expanded (EPS) or extruded (XPS) polystyrene board insulation may be used. However, they must be protected from fire and are unsuitable where hot bitumen, asphalt or solventborne adhesives – unless specifically formulated for the EPS or XPS – are to be applied.

Roof membranes

Typical roofing membranes for use with warm roofs are:

- single-ply sheet membranes
- a multi-layer torch-on modified bitumen.

Mainly installed in roof refurbishment

At present, warm roofs are mainly installed in New Zealand in roof refurbishments such as when a low-slope roof needs replacement or the roof slope of an existing roof needs to be increased.

However, the benefits of warm roofs are making them more popular for new low-slope or skillion roofs. Although they are somewhat more expensive to construct, the benefits of improved thermal efficiency and reduced heating and cooling costs are able to offset increased construction costs.

The major advantage of a warm roof in a roof refurbishment is that it can be installed directly over the existing roof. This eliminates demolition costs removing the existing roof, and building weathertightness is maintained throughout the refurbishment as the building interior is not exposed.

Several proprietary systems

There are several proprietary warm roof systems available in New Zealand, some of which are BRANZ Appraised.

Proprietary warm roof systems should be installed strictly according to the manufacturer's instructions.

Inverted warm roof variation

An inverted roof system is a variation on the warm roof.

The insulation is installed over the waterproof membrane and then protected by pavers, planting or loose gravel ballast – typically 20–40 mm diameter washed pebbles. These shield the insulation from the effects of UV light and wind uplift. Pavers also allow the roof to be used for recreation or for housing service units.

An inverted warm roof has additional load imposed by the ballast layer, which may increase the building structure costs.

Inverted warm roofs are not commonly used in New Zealand.