



INSULATION THICKNESS AND R-VALUES

It is essential to consider the thickness of insulation product needed to achieve the required R-value when designing a low-slope or skillion roof structure. For a given R-value, product thicknesses can be quite different.

By **Tony Conder**, Freelance Technical Writer, Upper Hutt

Using the schedule method, the minimum roof construction R-values required to comply with Building Code clause H1 *Energy efficiency* are shown in Table 1. These R-values relate to the construction R-value (roofing, underlay, structure, insulation product, ceiling linings and air gaps that make up the roof construction). The R-value of the installed insulation product required to achieve these construction R-values can be found in the *BRANZ House insulation guide*. This article includes details of BRANZ Appraised insulation products since these R-values have been validated.

Size rafter for insulation, not span

Insulation material must fit without being compressed and a 25 mm gap maintained between the insulating product and any non-rigid roof underlay. Where a rigid underlay is used, the 25 mm gap may not be needed – refer to the plywood manufacturer’s requirements.

Where the 25 mm gap is required, it can be formed by the purlin depth. The insulation should not be compressed under the purlin, as this will reduce its installed R-value. Similarly, remember that the actual product thickness is likely to be greater than the nominal values shown in Table 2.

The best advice is to ensure that the insulation will fit within the rafter depth. This may mean that the rafter is sized to accommodate the insulation, rather than sized for the span.

Low slope roof example

For a low-slope timber-framed roof with a waterproof membrane cladding, the span of the rafters at 400 mm centres requires at least 140 mm deep members (see Figure 1). If this building (of non-solid construction) is sited in climate zone 2, the construction R-value of the roof or deck will need to be 2.9.

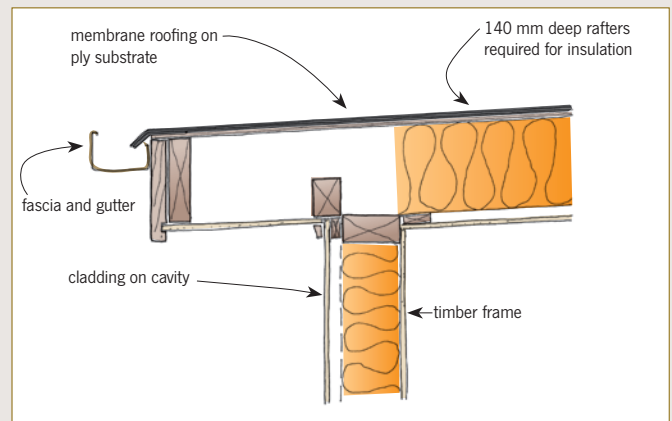


Figure 1: Low-slope roof.

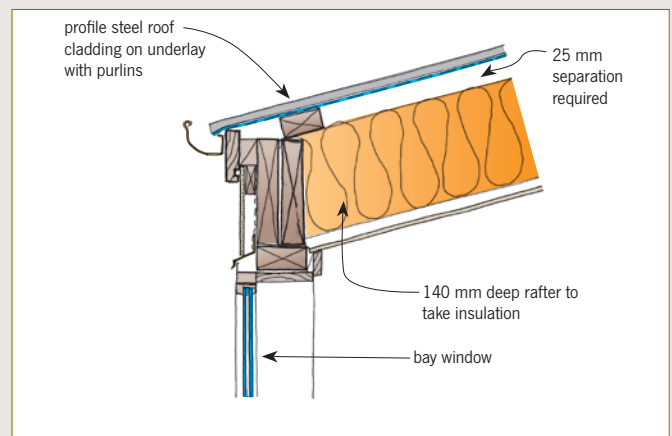


Figure 2: Skillion roof.

Table 1: Construction R-values.

Non-solid construction	
Climate zone 1	R2.9
Climate zone 2	R2.9
Climate zone 3	R3.3
Solid construction	
	R3.5

Using the graph from page 5 of the supplement to the *BRANZ House insulation guide*, an insulating product with an R-value of 3 is needed to achieve a construction R-value of 2.9.

Using Table 2 to select an insulation material, two manufacturers have products that achieve exactly R2.7, but only one of them will fit into the 140 mm gap. The same manufacturer has a R2.9 product that (at 125 mm) will also fit into a 140 mm gap and provide a better level of insulation. If a different manufacturer’s product is specified, a higher →

R-value product will be needed, and in this case, the joist depth of 140 mm must be increased to at least 190 mm to fit the product.

Skillion roof example

A profiled steel-clad skillion roof over a bay window may structurally only require 90 mm rafters at 600 mm centres. However, as this roof forms part of the thermal envelope, it will be required to have an R-value equal to the remainder of the roof construction. In climate zone 3, using the schedule method, this will need to be R3.3.

To achieve a construction R-value of 3.3, using the *BRANZ House insulation guide* (see page 35 – rafters and dwangs), an insulating material of R3.4 will be required. None of the available insulating materials will fit within the depth of a 90 mm rafter, but by selecting a 140 mm deep rafter, it is possible to fit a wider choice of products including R-values that exceed the minimum (see Figure 2). ❖

Note: Only BRANZ Appraised insulation products are shown, as these are the only products with validated R-values.

Table 2: BRANZ Appraised insulation products showing R-values and nominal thickness (mm).

Type	Glasswool						Polyester		Wool	Cellulose
	Earthwool	Polygold	Knauf	Premier	Bradford	Pinkbatts	Greenstuf	Novatherm	Ecotherm	Insulfluf
2.3		100			100					
2.5	125		125	100						
2.6					120	140		165		156
2.7				120	125					
2.9				125			175		145	182
3.0	145									
3.2					145	170	180	200		
3.3	150		150	145						215
3.4							190			
3.5	175		175							
3.6		140		155	185	180				
3.8	185									
4.0	195		195	175		190				
4.6						195				
5.0	210		210		210	200				
6.0	275				260					