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Webinar

Roofs

About us

Stephen McNeil

Greg Burn

Supported by

Building Research Levy

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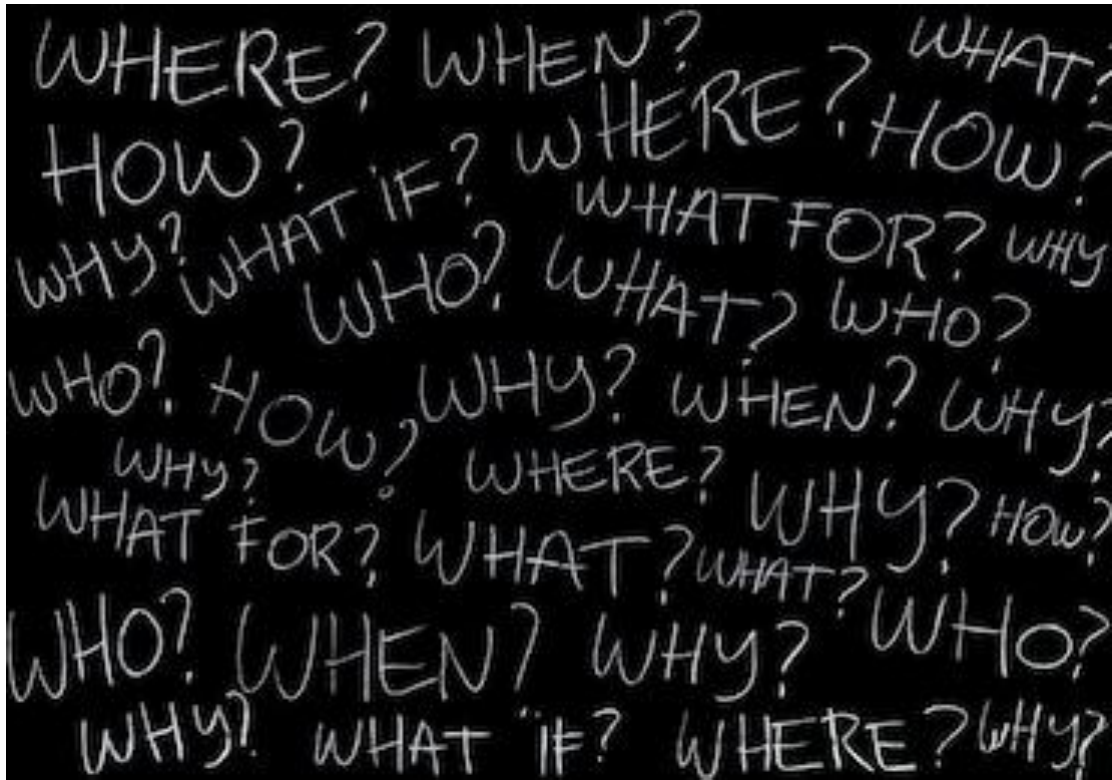
Questions

There will be a question and answer session at the end of the presentation



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Programme

R-values

Compliance:
- Requirements
- Methodologies

Insulation

Roof typologies

Ceiling air barriers

Ventilation

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H1 *Energy efficiency*

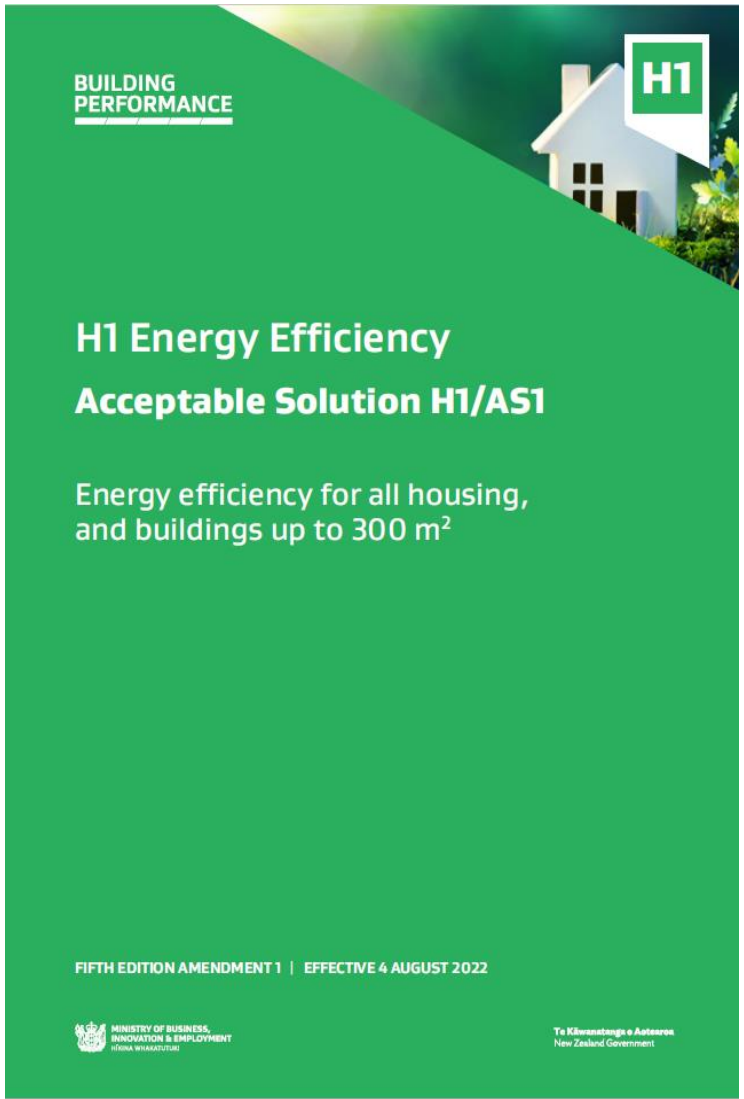
Compliance documents H1/AS1 and H1/VM1 5th edition amendment 1

"Energy efficiency for all housing, and buildings up to 300 m²"

Definition of "housing" in scope of documents

Effective 4 August 2022

Building consents from 1 May 2023



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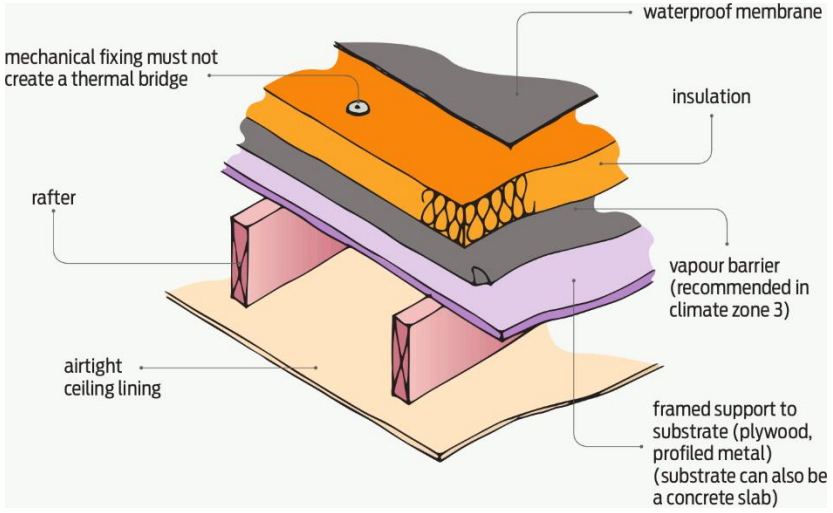
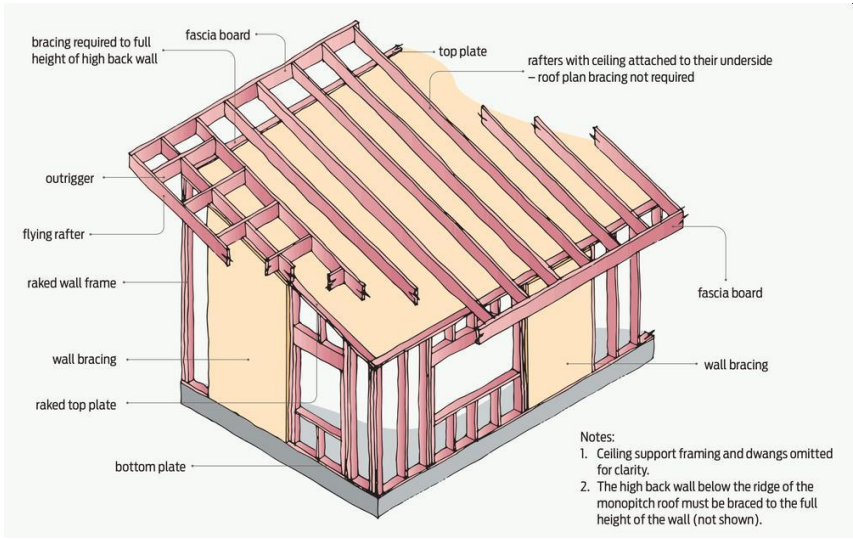
Roof types covered

- Framed/truss
- Skillion
- Warm
- Hybrid

Unheated ceilings only (H1/AS1 Table 2.1.2.2B)





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R-values

Thermal resistance measurement

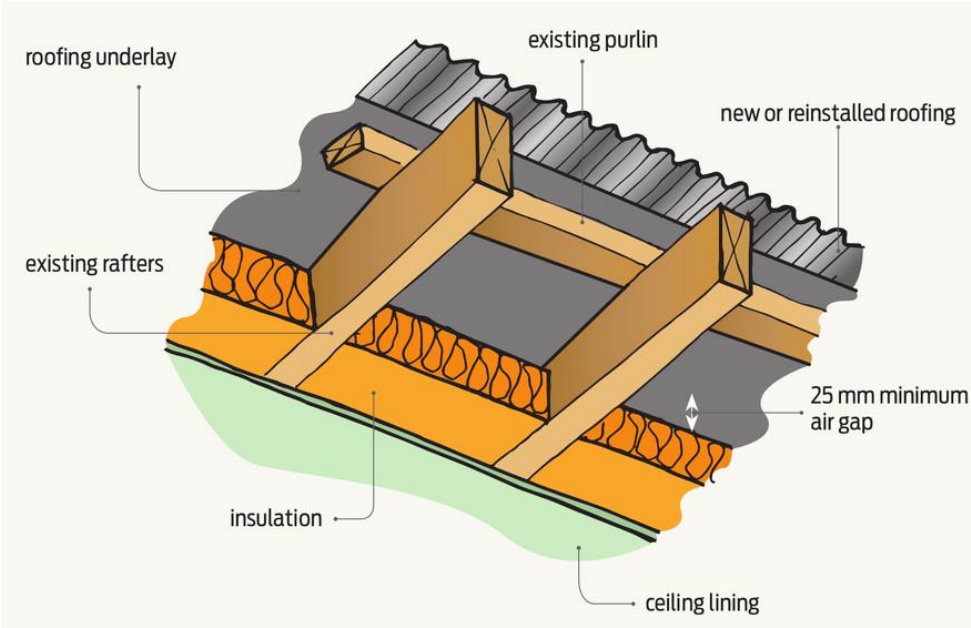
Component R-value:

- Thermal resistance of specific component/element

Construction R-value:

- Thermal resistance of the constructed assembly – taking into account each of the elements

Construction R-value could be higher *or* lower than the R-value of the insulation material used in the roof



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H1 roof compliance

H1/AS1

For building consents submitted before 1 May 2023, minimum construction R-value for compliance was lower

TABLE 2.1.2.2C: Alternative minimum construction R-values for building elements that do not contain embedded heating systems – for housing only where building consent applications are submitted before 1 May 2023

Paragraph 2.1.2.2 b)

Building element	Construction R-values (m²·K/W)	
	Region A [1]	Region B [2]
Roof	R2.9	R3.3
Wall	R1.9	R2.0
Floor	R1.3	R1.3
Windows and doors	R0.37	R0.37
Skylights	R0.37	R0.37

Notes:

(1) Region A comprises all of the North Island/Te Ika-a-Māui excluding the Taupo District, the Ruapehu District and the part of the Rangitikei District north of 39°50′S (-39.83), and all offshore islands north of 37°15′S (-37.25).

(2) Region B comprises the Taupo District, the Ruapehu District, the part of the Rangitikei District north of 39°50′S (-39.83), the South Island/Te Waipounamu, Stewart Island/Rakiura, the Chatham Islands, and all offshore islands south of 37°15′S (-37.25).

COMMENT: Region A in Table 2.1.2.2C and Table 2.1.3.4B is consistent with the previous climate zones 1 and 2 defined in NZS 4218: 2009. Region B is consistent with the previous climate zone 3 defined in NZS 4218: 2009. The NZS 4218 climate zones are different to the current six climate zones defined in Appendix C.

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H1 roof compliance

H1/AS1 minimum construction R-values

All roof types

Building consents submitted from 1 May 2023 – significant increase

Options	Climate zone					
	1	2	3	4	5	6
Roofs						
Current minimum requirements		R2.9	R2.9/3.3		R3.3	
From 1 May 2023			R6.6↑			

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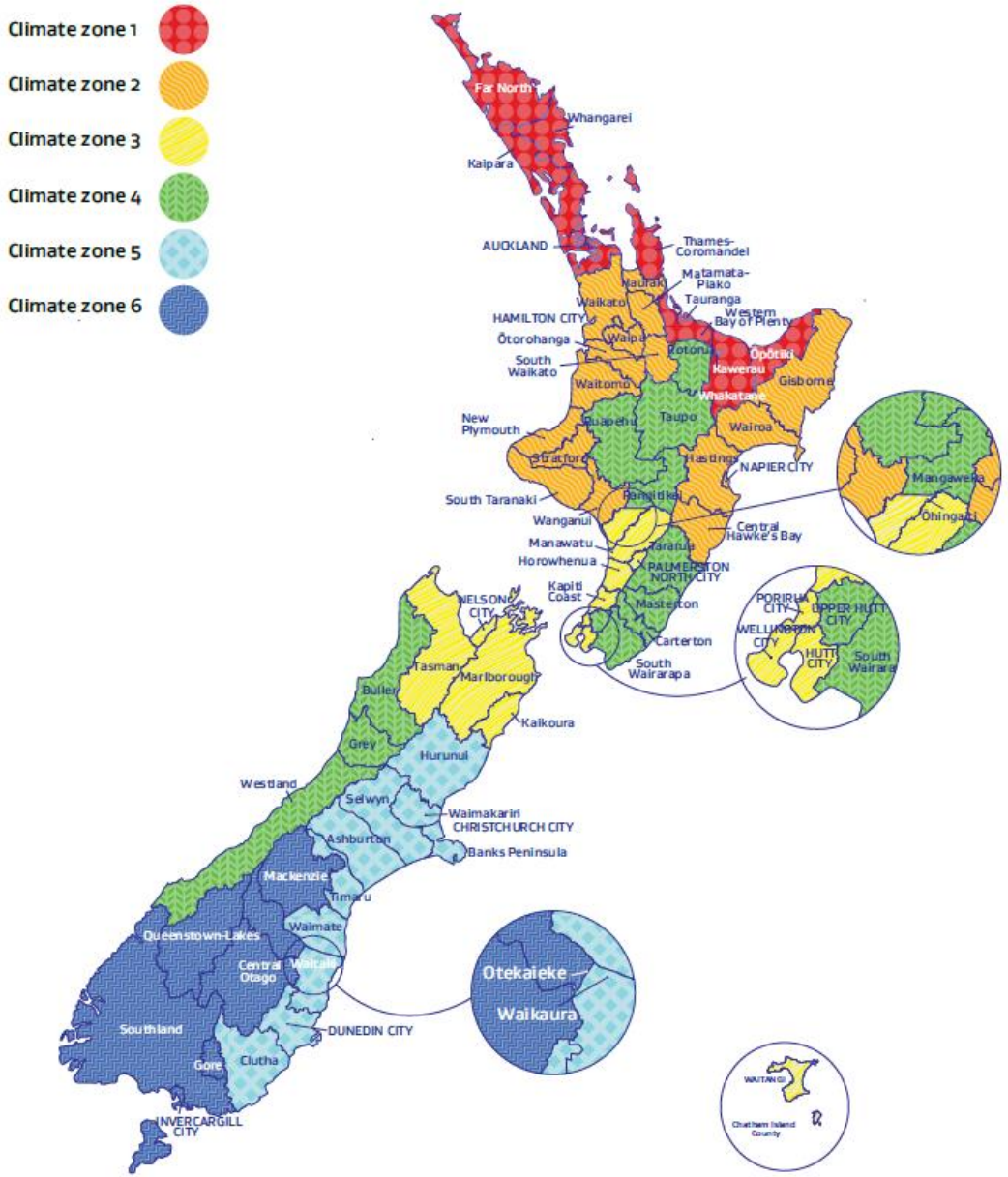
H1 roof compliance

Six climate zones

Allow for more representative outcomes across AS/VM compliance routes

FIGURE C.1.1.2: Map of New Zealand climate zones

Paragraph C.1.1.2



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H1 roof compliance

H1/AS1 Table 2.1.2.2B minimum construction R-values

TABLE 2.1.2.2B: Minimum construction R-values for building elements that do not contain embedded heating systems

Paragraph 2.1.2.2 b)

Building element	Construction R-values (m²·K/W)[1]					
	Climate zone 1	Climate zone 2	Climate zone 3	Climate zone 4	Climate zone 5	Climate zone 6
Roof[2]	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6
Wall	R2.0	R2.0	R2.0	R2.0	R2.0	R2.0
Floor						
Slab-on-ground floors	R1.5	R1.5	R1.5	R1.5	R1.6	R1.7
Floors other than *slab-on-ground*	R2.5	R2.5	R2.5	R2.8	R3.0	R3.0
Windows and doors[3]	R0.46[3]	R0.46[3]	R0.46	R0.46	R0.50	R0.50
Skylights	R0.46	R0.46	R0.54	R0.54	R0.62	R0.62

Notes:

(1) Climate zone boundaries are shown in Appendix C.

(2) In *roofs* with a *roof* space, where the insulation is installed over a horizontal ceiling, the *roof R-value* may be reduced to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where space restrictions do not allow the full-thickness of insulation to be installed.

(3) For *building consent* applications submitted before 2 November 2023, the minimum *construction R-values* for windows and doors in climate zones 1 and 2 are permitted to be reduced to R0.37 m²·K/W.

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H1 roof compliance

H1/AS1

Minimum construction R-value:

- Concession to reduce from R6.6 to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where insulation is installed over a horizontal ceiling

Notes:

(1) Climate zone boundaries are shown in Appendix C.

(2) In *roofs* with a *roof* space, where the insulation is installed over a horizontal ceiling, the *roof R-value* may be reduced to R3.3 for a distance of up to 500 mm from the outer edge of the ceiling perimeter where space restrictions do not allow the full-thickness of insulation to be installed.

(3) For *building consent* applications submitted before 2 November 2023, the minimum *construction R-values* for windows and doors in climate zones 1 and 2 are permitted to be reduced to R0.37 $m^2 \cdot K/W$.

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H1 roof compliance methodologies

H1/AS1 schedule method

- Tabulated minimum construction R-values

H1/AS1 calculation method

- Simplified comparison methodology that permits different insulation combinations

H1/VM1 modelling method

- More complex comparison methodology that permits different insulation combinations

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H1/AS1 schedule method

Must meet or exceed specific level of thermal performance (construction R-values in Tables 2.1.2.2A or 2.1.2.2B)

Must know the R-values of all building elements in the proposed building

Can only be used where:

- Glazing area is 30% or less of total wall area
- Combined glazing area on east, south and west-facing walls is 30% or less of the total area of these walls
- Skylight area is no more than 1.5 m² or 1.5% of total roof area (whichever is greater)
- Opaque door area is no more than 6 m² or 6% of total wall area (whichever is greater)

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H1/AS1 calculation method

Compares thermal performance of proposed building with a reference building

The requirements for each building element in the reference building are the same as those in the schedule method (construction R-values in Tables 2.1.2.2A or 2.1.2.2B)

The proposed building overall must perform at least as well as the reference building (in W/K) but R-value combinations can differ from those in the reference building

This allows for offsetting elements by increasing insulation in other areas

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H1/AS1 calculation method

Can only be used where glazing area is 40% or less of total wall area

The construction R-value for roofs, walls and floors in the proposed building must be at least 50% of the construction R-value of the corresponding building element in the reference building

Acceptable Solution E3/AS1 also specifies minimum R-values for roofs and ceilings

$HL_{Proposed}$ shall be calculated as the sum of all the *building element* heat losses according to Equation 2.

Equation 2: $$HL_{Proposed} = \frac{A_{roof}}{R_{roof}} + \frac{A_{wall}}{R_{wall}} + \frac{A_{floor}}{R_{floor}} + \frac{A_{glazing}}{R_{window}} + \frac{A_{door,\ opaque}}{R_{door,\ opaque}} + \frac{A_{skylight}}{R_{skylight}}$$

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H1/AS1 calculation method

To help designers, BRANZ has an Excel-based H1 calculation method tool available online and is currently developing an interactive tool

Previous BRANZ webinars also available online

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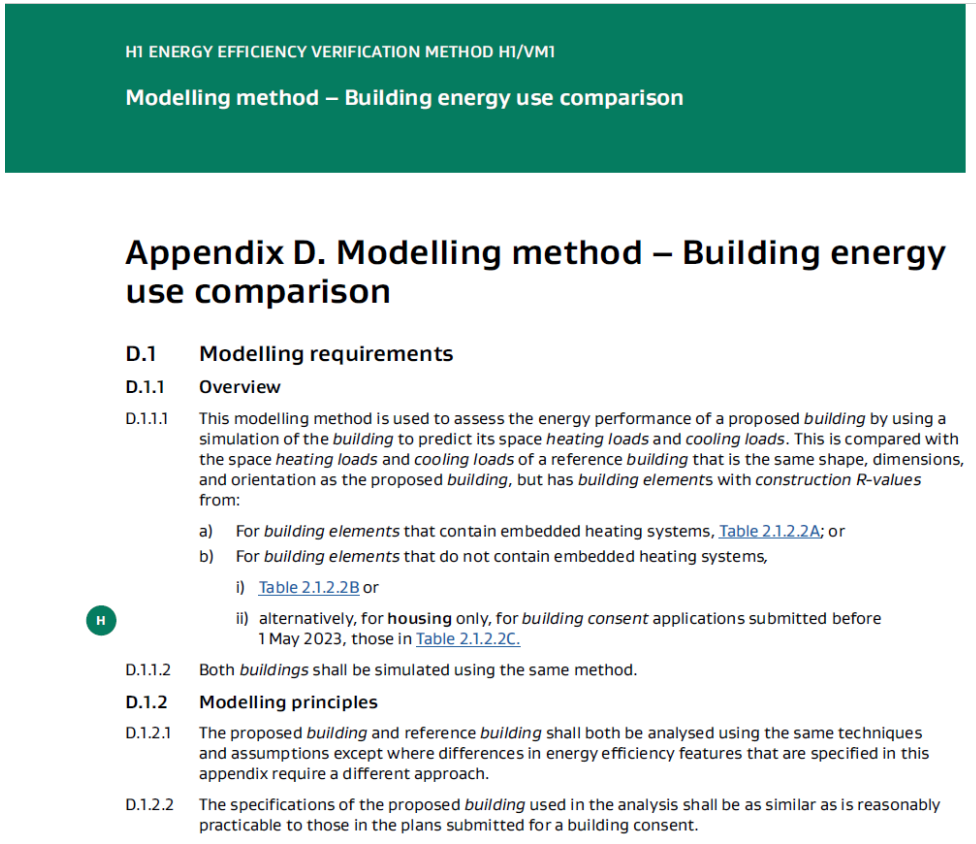
H1/VM1 modelling method

Modelling compares thermal performance of proposed building with a reference building that is the same shape, dimensions and orientation

The requirements for each building element in the reference building are the same as those in the schedule method (construction R-values in Tables 2.1.2.2A or 2.1.2.2B)



H1 ENERGY EFFICIENCY VERIFICATION METHOD H1/VM1

Modelling method – Building energy use comparison

Appendix D. Modelling method – Building energy use comparison

D.1 Modelling requirements

D.1.1 Overview

D.1.1.1 This modelling method is used to assess the energy performance of a proposed *building* by using a simulation of the *building* to predict its space *heating loads* and *cooling loads*. This is compared with the space *heating loads* and *cooling loads* of a reference *building* that is the same shape, dimensions, and orientation as the proposed *building*, but has *building elements* with *construction R-values* from:

a) For *building elements* that contain embedded heating systems, Table 2.1.2.2A; or

b) For *building elements* that do not contain embedded heating systems,

i) Table 2.1.2.2B or

H ii) alternatively, for **housing** only, for *building consent* applications submitted before 1 May 2023, those in Table 2.1.2.2C.

D.1.1.2 Both *buildings* shall be simulated using the same method.

D.1.2 Modelling principles

D.1.2.1 The proposed *building* and reference *building* shall both be analysed using the same techniques and assumptions except where differences in energy efficiency features that are specified in this appendix require a different approach.

D.1.2.2 The specifications of the proposed *building* used in the analysis shall be as similar as is reasonably practicable to those in the plans submitted for a building consent.

H1/VM1 modelling method

Verification achieved by demonstrating that the energy use of the proposed building does not exceed the energy use of the reference building (using computer modelling described in Appendix D)

The sum of the calculated annual heating load and cooling load of the proposed building shall not exceed that of the reference building

D.6 Documentation

D.6.1 Documentation of analysis

D.6.1.1.1 Documentation of computer modelling analysis shall contain:

a) The name of the modeller;

b) The thermal modelling program name, version number, and supplier;

c) Technical detail on the proposed *building* and reference *building* designs and the differences between the designs;

d) The sum of the *heating load* and *cooling load* for the proposed *building* and reference *building*;

e) Where possible, the *heating load* and *cooling load* for the proposed *building* and the reference *building*.

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H1 compliance methodologies

Preference for using:

- Calculation method
- Modelling method

Good tools available for both

Tools allow comparisons of thermal performance solutions

Modelling services available

BRANZ Bulletin BU684 *Thermal modelling tools for houses* – available late April

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BRANZ *House insulation guide*

Updated 6th edition

Used to help demonstrate compliance

Tables in the guide can be used to:

- Find the construction R-value of a built system for a given level of insulation
- Find the level of insulation required to achieve a specific construction R-value

Allows for the design of buildings that exceed Building Code minimum insulation

Warm, dry and healthy homes

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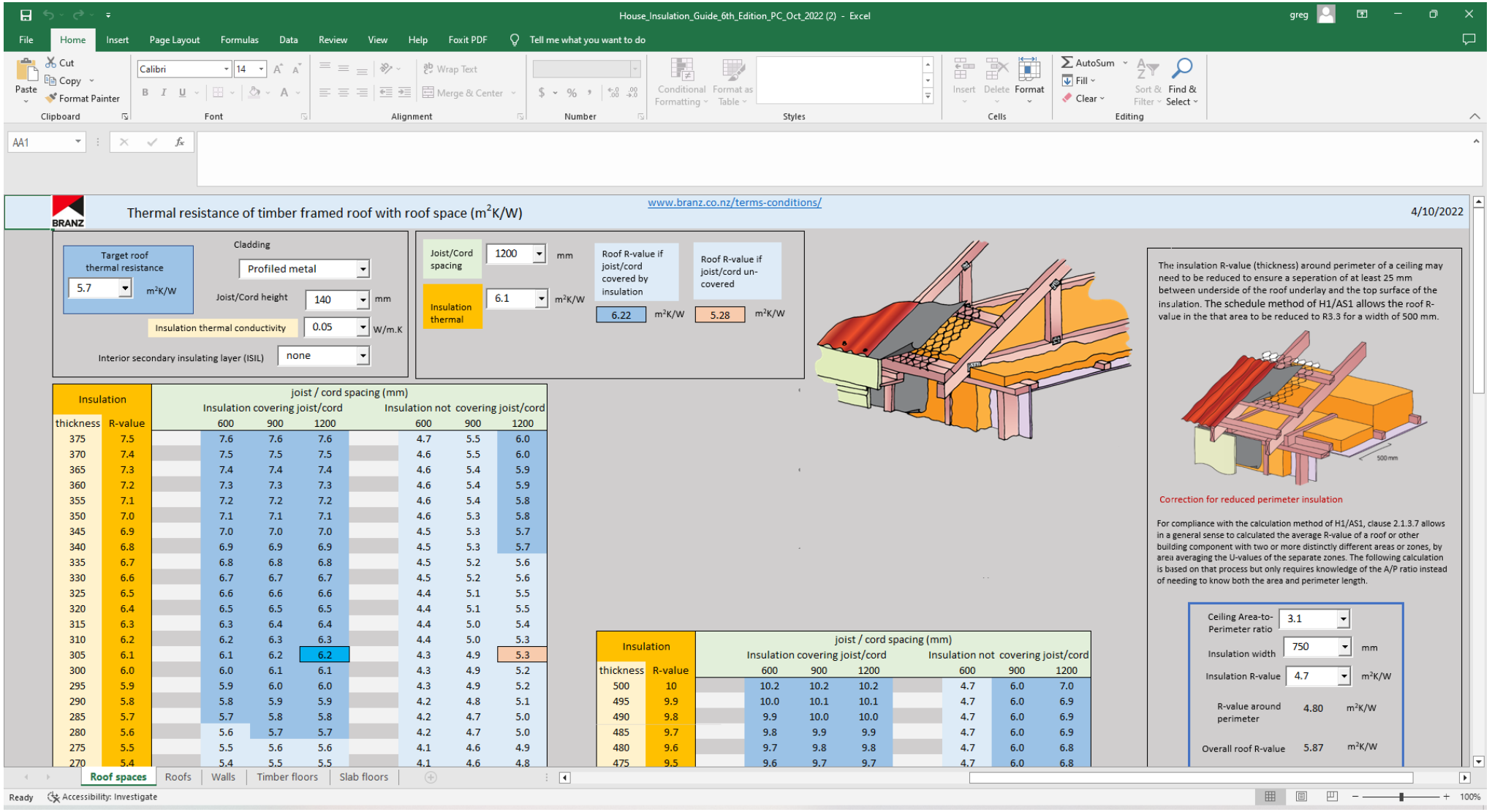
BRANZ *House insulation guide*

Excel format

Text guidance



Roofs

H1/AS1

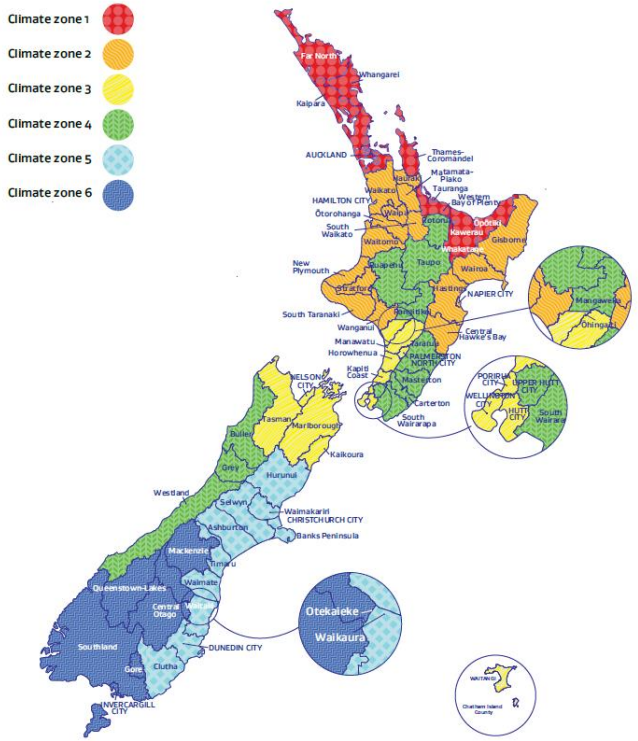
Minimum construction R-value:

- R6.6 (climate zones 1–6)

Significant increase

FIGURE C.1.1.2: Map of New Zealand climate zones

Paragraph C.1.1.2



Options	Climate zone					
	1	2	3	4	5	6
Roofs						
Current minimum requirements	R2.9		R2.9/3.3		R3.3	
From 1 May 2023	R6.6↑					

Roof insulation considerations

Roof insulation:

- Available product
- Thickness required to meet construction R-value of R6.6
- Maintaining 25 mm minimum ventilation clearance to underside of roof underlay
- Stacked/layered
- Hybrid

Building element	Construction R-values ($m^2 \cdot K/W$)[1]					
	Climate zone 1	Climate zone 2	Climate zone 3	Climate zone 4	Climate zone 5	Climate zone 6
Roof[2]	R6.6	R6.6	R6.6	R6.6	R6.6	R6.6

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Available insulation products

Limited number of common single-layer products that allow construction R-value to be achieved

New products under development

Innovation opportunities

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Insulation thickness

Considerable increase for compliant common insulation products:

- Up to 290 mm product thickness for one-layer systems

Concession to reduce to R3.3 for 500 mm perimeter can help with some roof construction types but reduces overall thermal performance

House insulation guide can help with calculating the impact of the R3.3 concession

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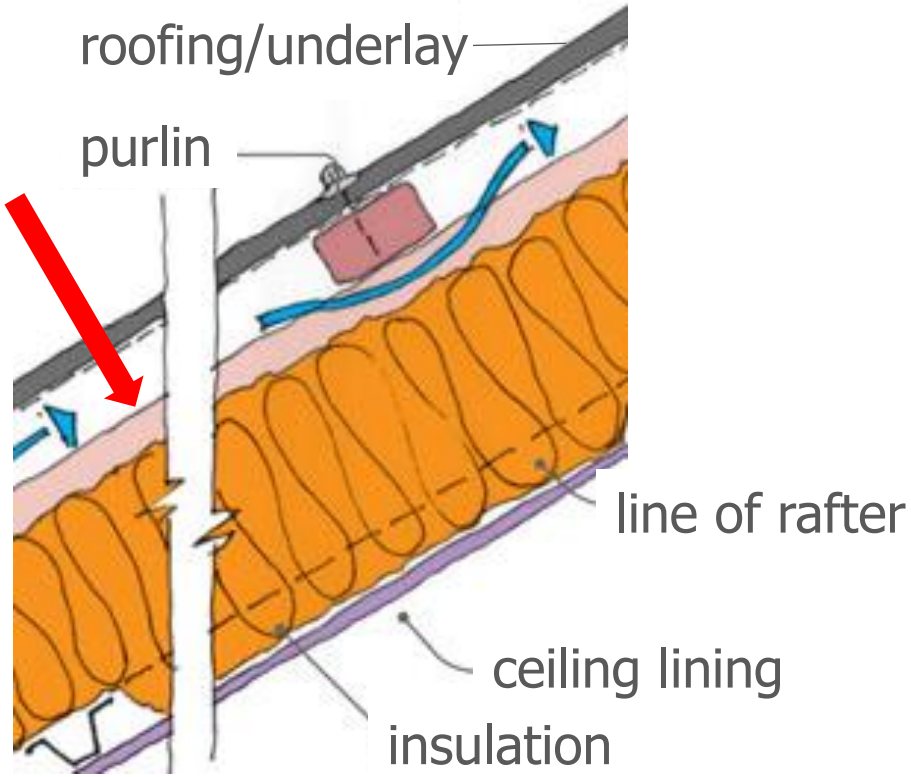
Maintaining 25 mm minimum ventilation clearance

Thickness of available/compliant products creates a challenge

Revised construction details – particularly for skillion roofs

Innovative solutions

minimum 25 mm ventilation gap between insulation and roof underlay



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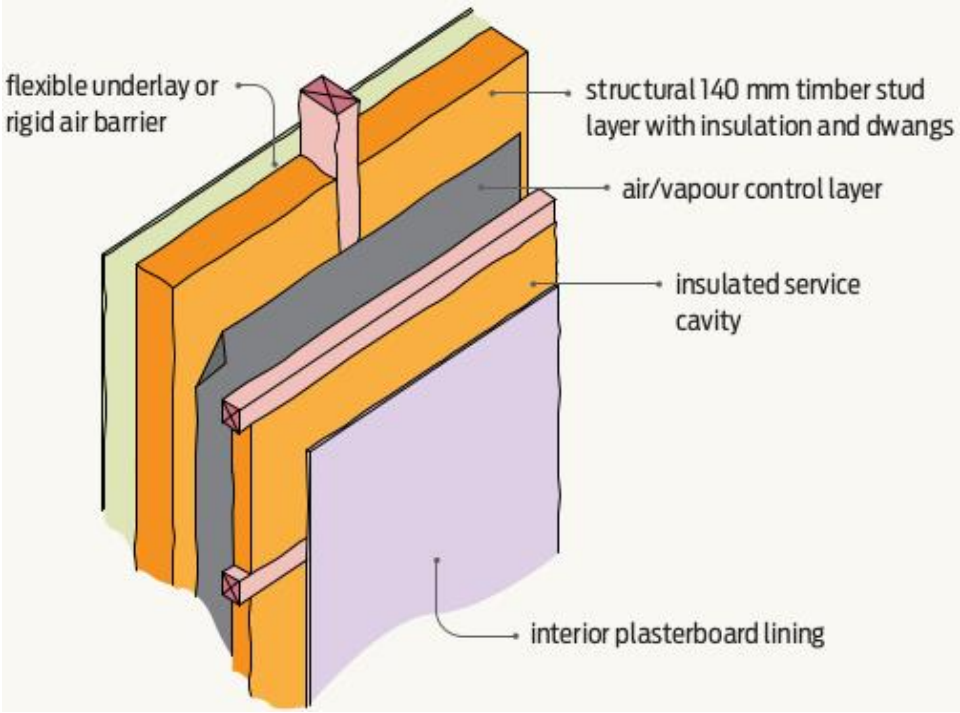
Comparisons of thermal performance solutions

Difficulty in providing enough construction depth to incorporate sufficient insulation may necessitate looking at alternatives

Calculation and modelling methods useful for looking at potentially reducing roof construction R-value:

- Allows comparisons to consider increasing other thermal envelope construction R-values to compensate



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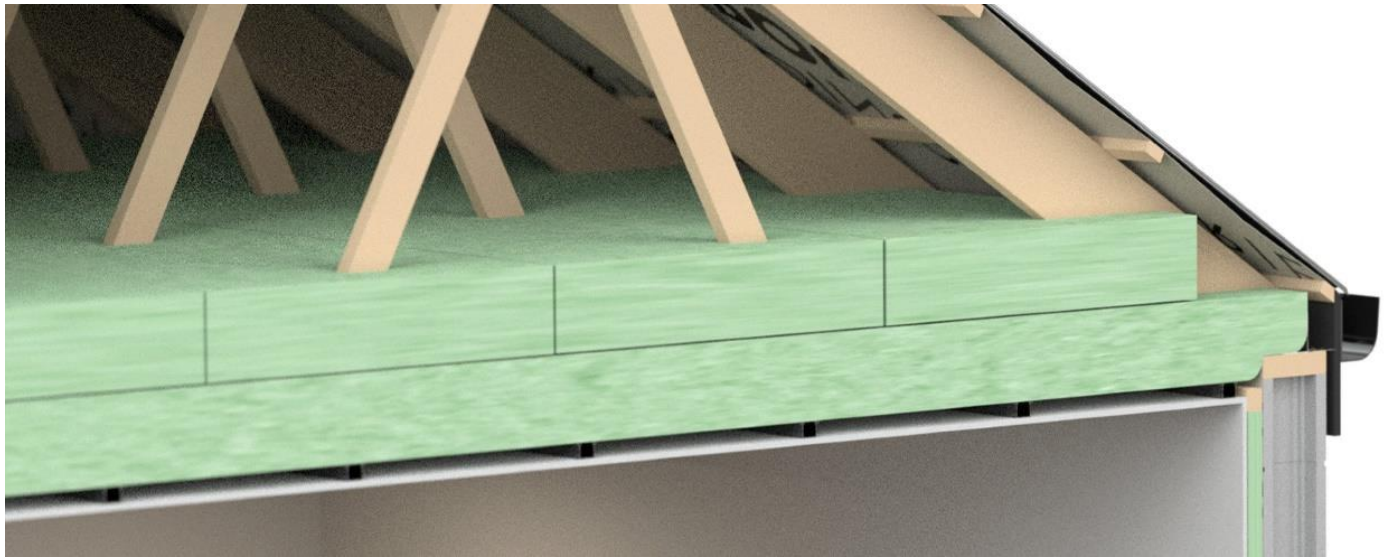
Stacked/layered insulation

Ability of product to maintain required thickness of bottom layer (compression)

Compression of lofted insulation reduces R-value

Need to also consider:

- Calculating/proving construction R-values
- Product compatibility
- Extra installation
- Difficulty of installation
- Cost



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Framed/truss roofs

Horizontal ceiling

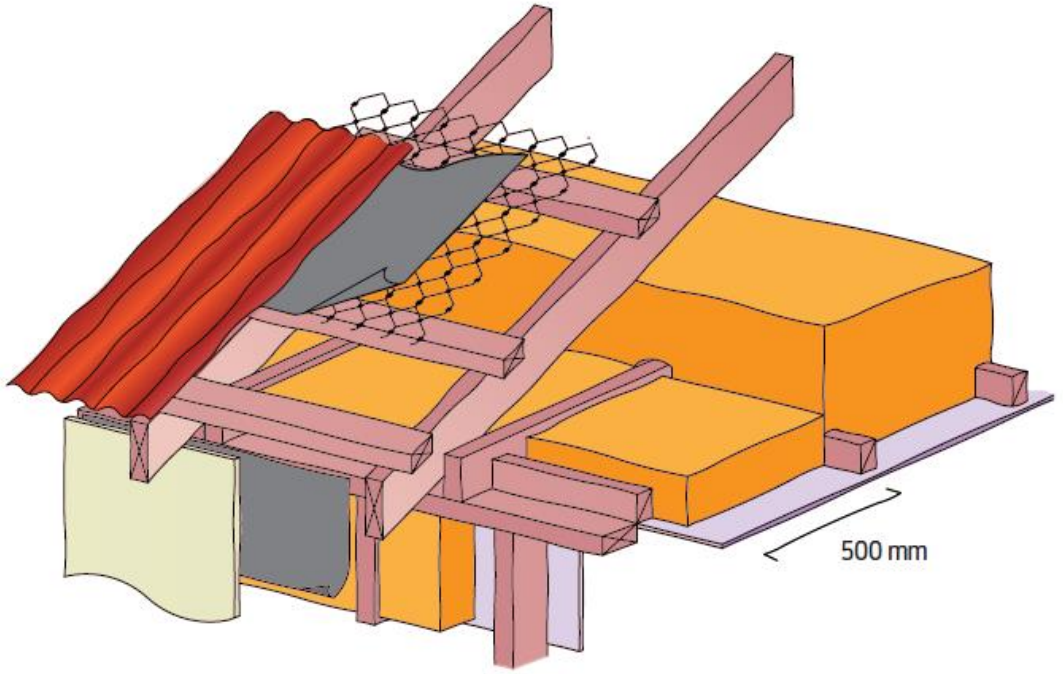
Insulation capacity varies with roof pitch/construction

Insulation on ceiling lining:

- More options utilising ceiling batten depth

500 mm perimeter concession

25 mm ventilation clearance must be maintained



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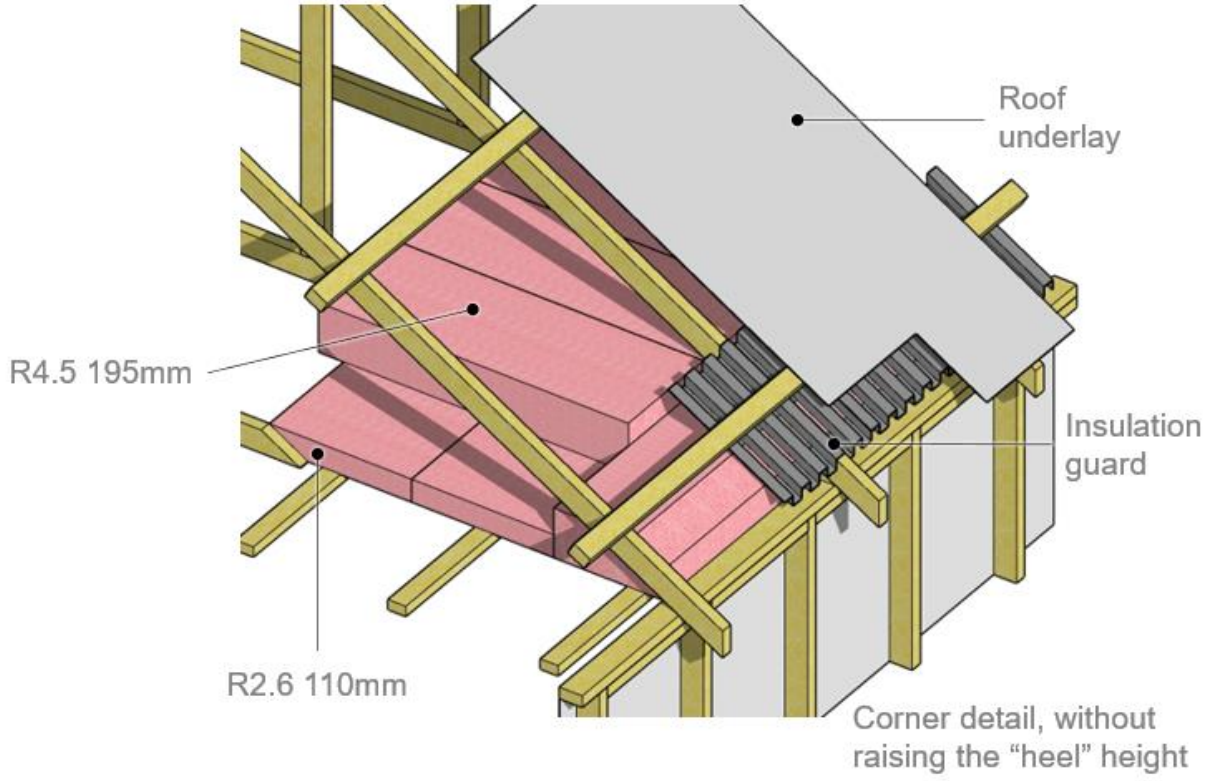
Framed/truss roofs – ventilation clearance

Ensure proprietary solutions such as insulation baffles (used to maintain 25 mm ventilation clearance) do not compress insulation thickness



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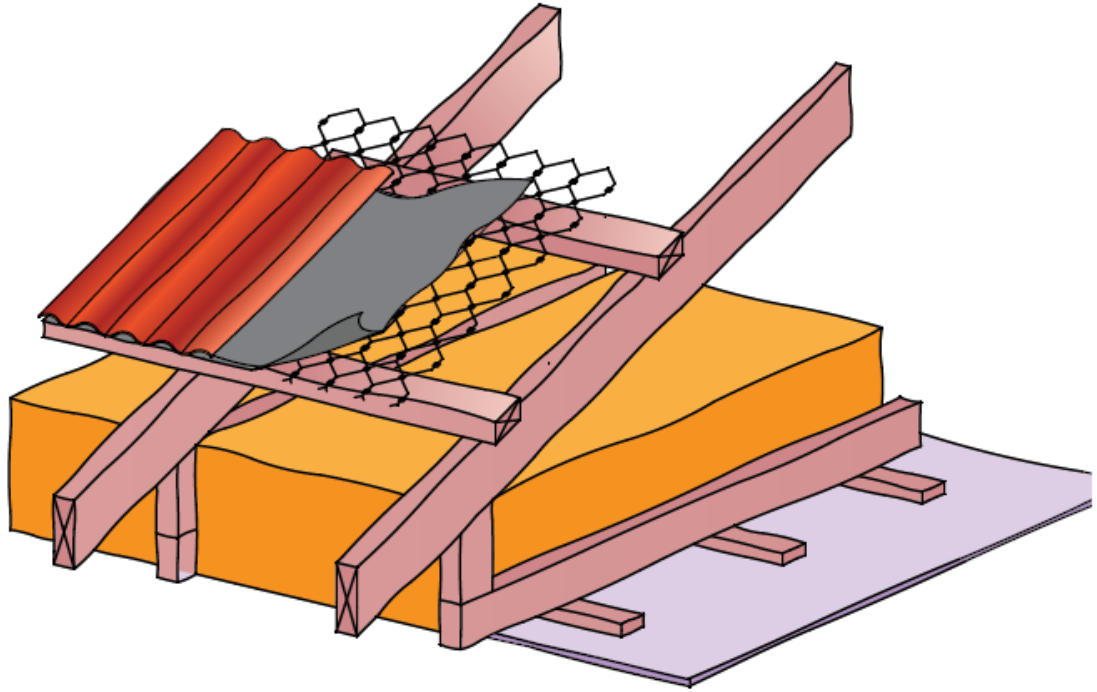
Framed/truss roofs – increasing insulation capacity

Horizontal ceiling on battens

Raised heel truss:

- Increases available depth at roof perimeter

Structural considerations – SED is a likely requirement (wall height/bracing/etc.)



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Framed/truss roofs – increasing insulation capacity

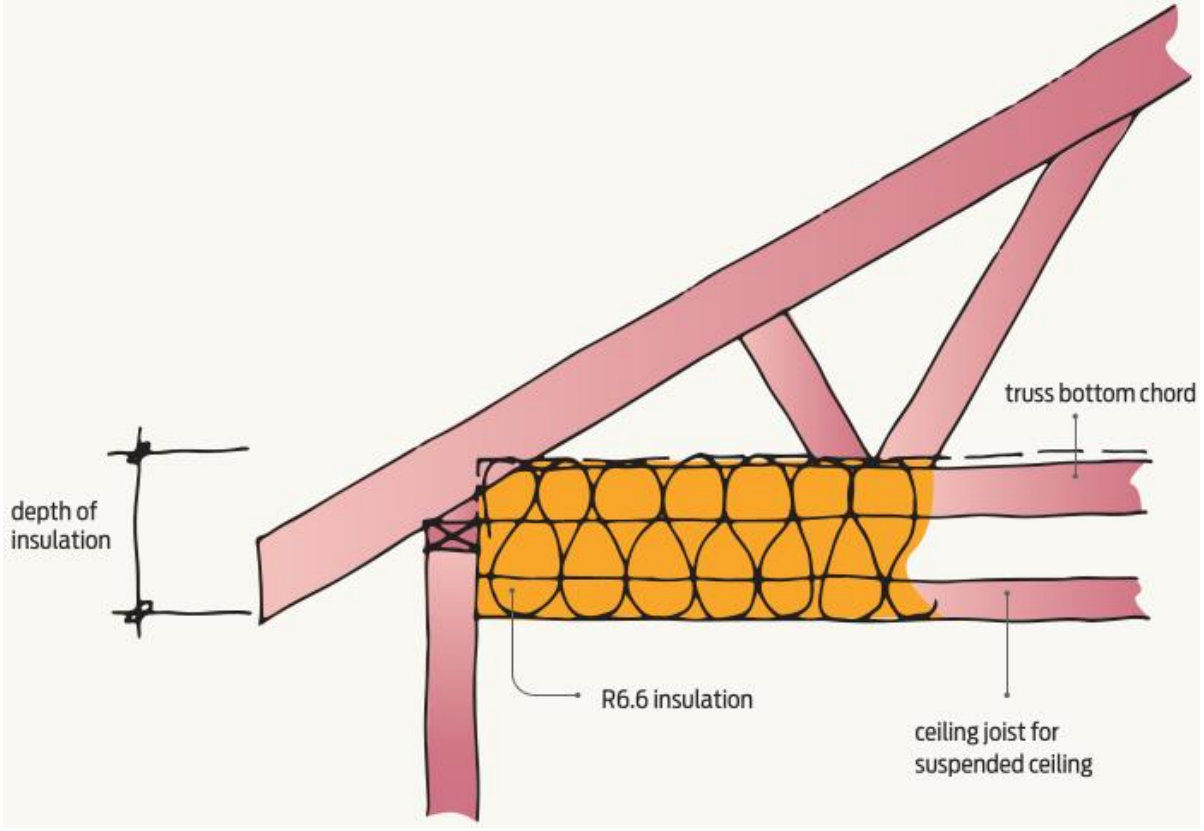
Horizontal ceiling on ceiling joists

Ceiling joists:

- Below bottom chord to form a dropped ceiling
- Increases available depth

Ceiling batten depth opportunity for thicker or second layer of insulation

Wall lining installation



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Skillion roofs

Insulation depth capacity relates to ceiling lining location:

- Topside of rafters (exposed rafters)
- Underside of rafters (enclosed rafters)

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Skillion roofs – exposed rafters

Available insulation depth set by purlin depth

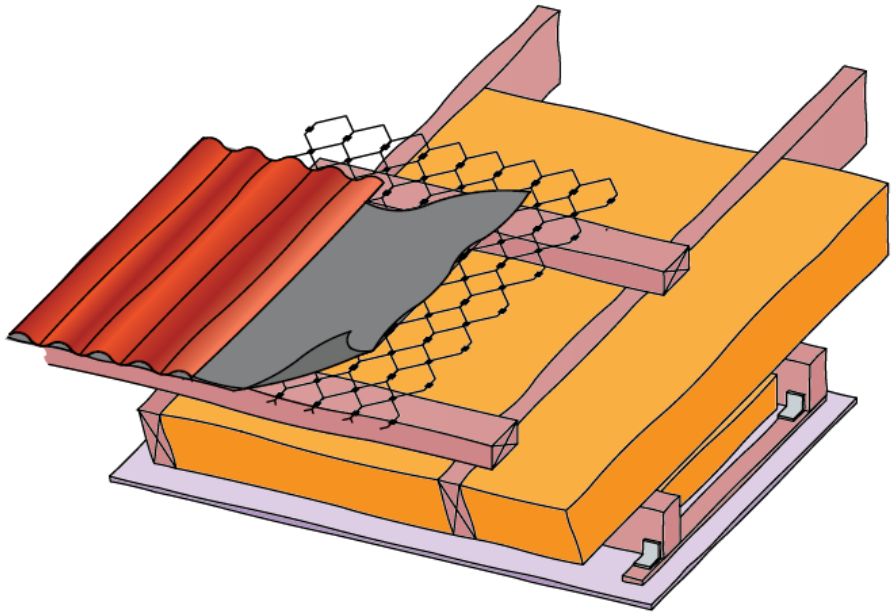
Construction to incorporate 25 mm ventilation space

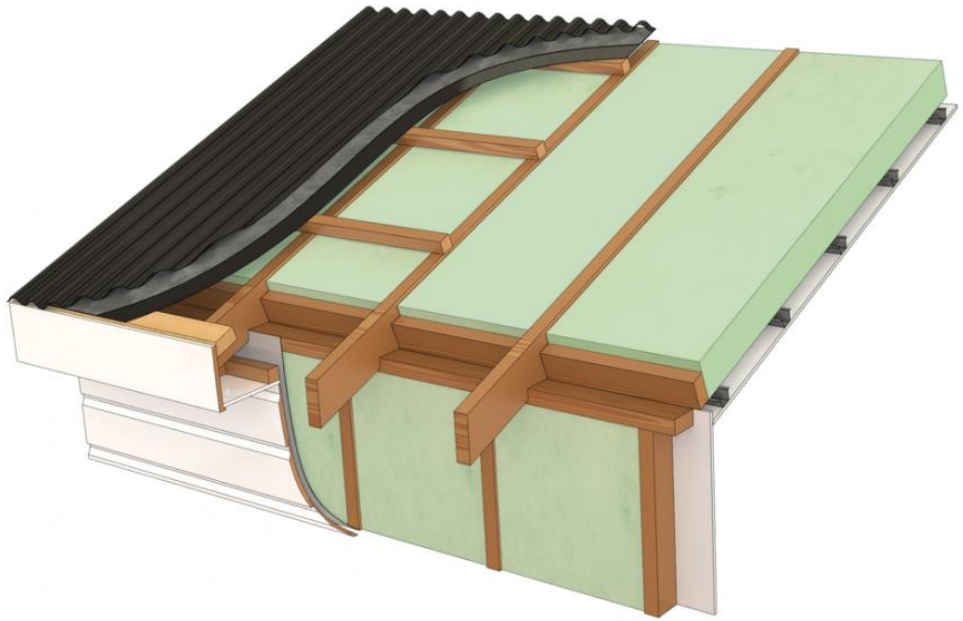
Skillion roofs – enclosed rafters

Available insulation depth set by rafter/purlin depth (where roof underlay on top of purlins)

Construction to incorporate 25 mm ventilation space

Ceiling batten depth opportunity for second layer of insulation





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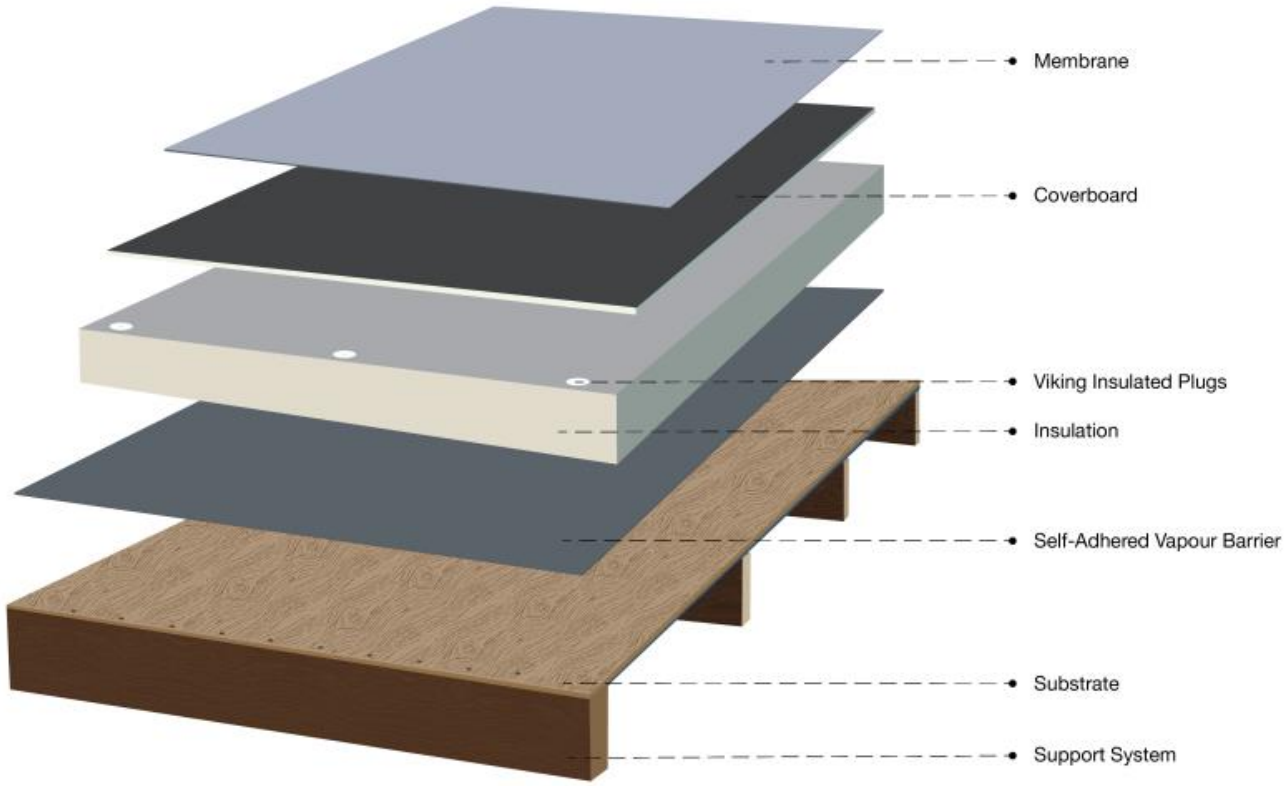
Warm roofs

Generally incorporate rigid insulation on the exterior of roof construction



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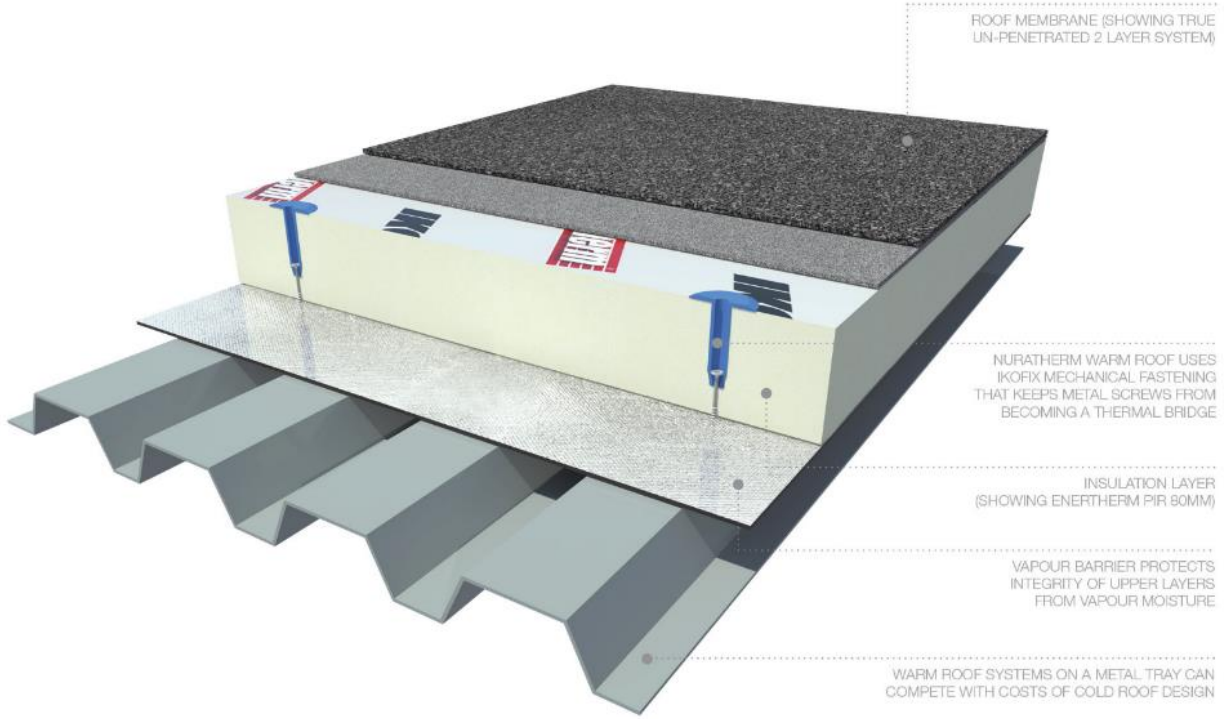
Warm roofs

Generally low pitch

Proprietary systems incorporating multiple layers

Rigid insulation supported by substrate and protected by roofing membrane/roofing



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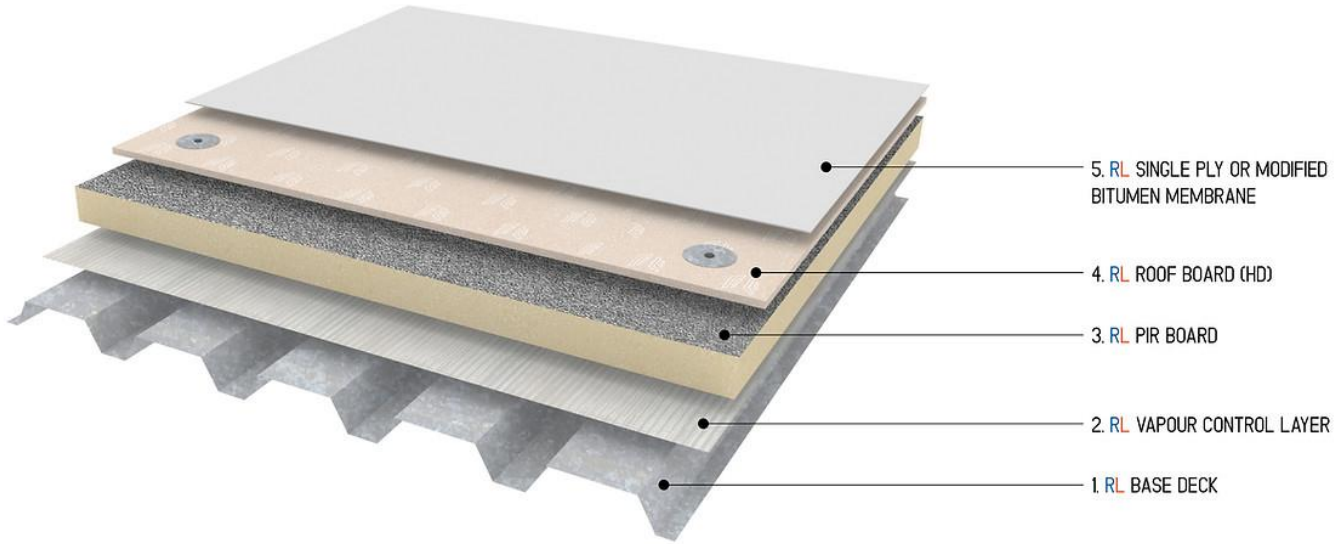
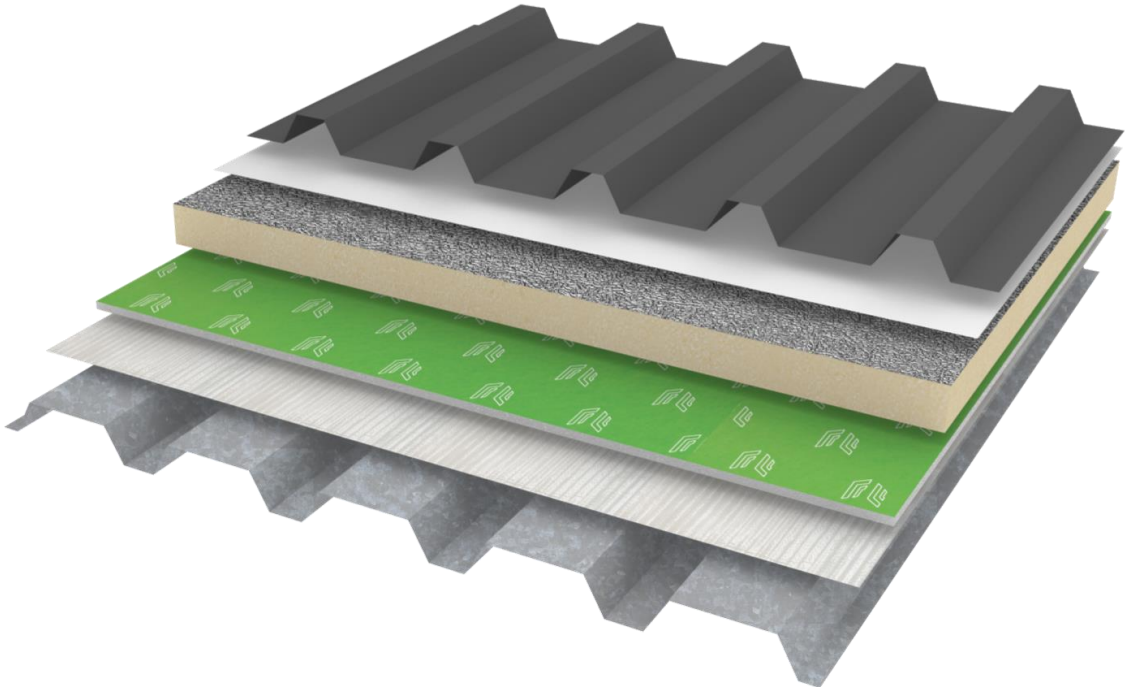
Warm roofs – considerations

Facilitate range of R-value insulation as less restriction on insulation thickness

Requirements for membrane ventilation

Can offer other performance benefits





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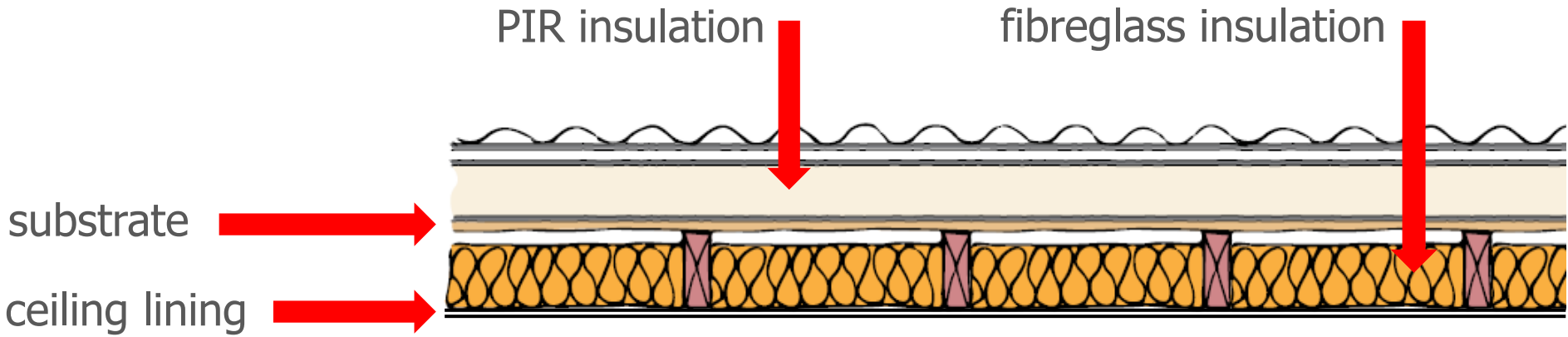
Hybrid roofs

Revised construction details incorporating layers of insulation

Similar/dissimilar insulation materials combined

Need to also consider:

- Calculating/proving R-values with combined insulation
- Product compatibility
- Installation sequence
- Extra installation
- Cost



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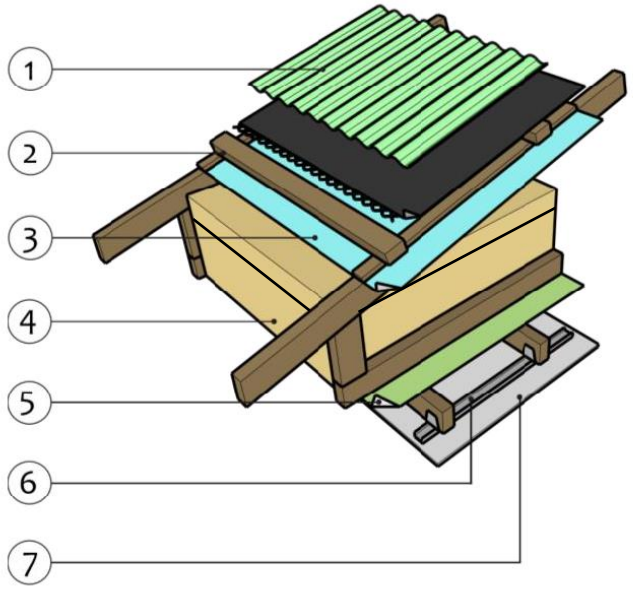
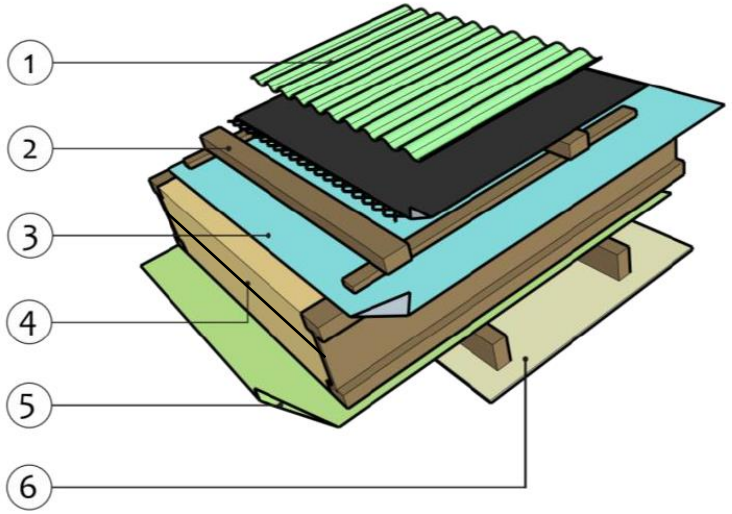
High-performance details

Range of high-performance details/thermal performance data available for roofs



Timber truss roof:

1. Roofing, underlay and safety mesh
2. Counter batten and purlin (ventilated)
3. Roof underlay vapour open membrane
4. Timber truss and fibre insulation ventilated
5. Air/vapour control layer membrane
6. Service cavity timber blocking with steel batten system showr
7. Interior finish plasterboard



Skillion roof timber I-joist rafters:

1. Roofing, underlay and safety mesh
2. Counter batten and purlin ventilated
3. Roof underlay vapour open membrane
4. Timber I-joist rafters and fibre insulation fully filling the rafters
5. Air/vapour control layer membrane
6. Interior finish plasterboard with optional service cavity.

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Ceiling air barrier

Air barriers restrict movement of air from the building interior into the roof space

Warm air moving into the colder roof space can cause condensation to occur within the roof space

Ensure the ceiling lining/finish forms an effective air barrier

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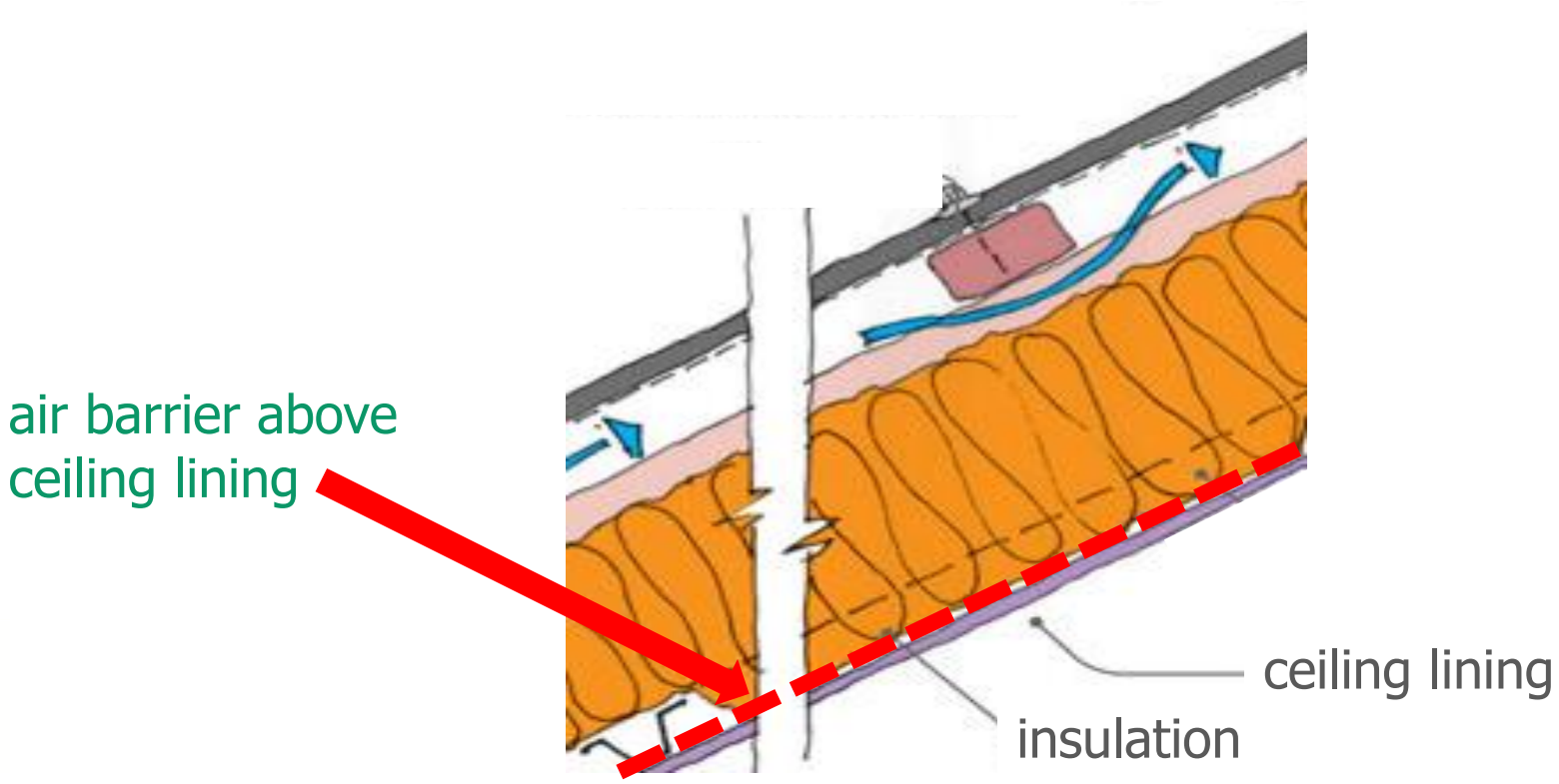
Ceiling air barrier

A well-painted plasterboard ceiling with minimal penetrations (that are sealed) forms an effective air barrier

Where ceiling linings incorporate joints (e.g. timber sarking), an air barrier should be incorporated in the ceiling/roof assembly



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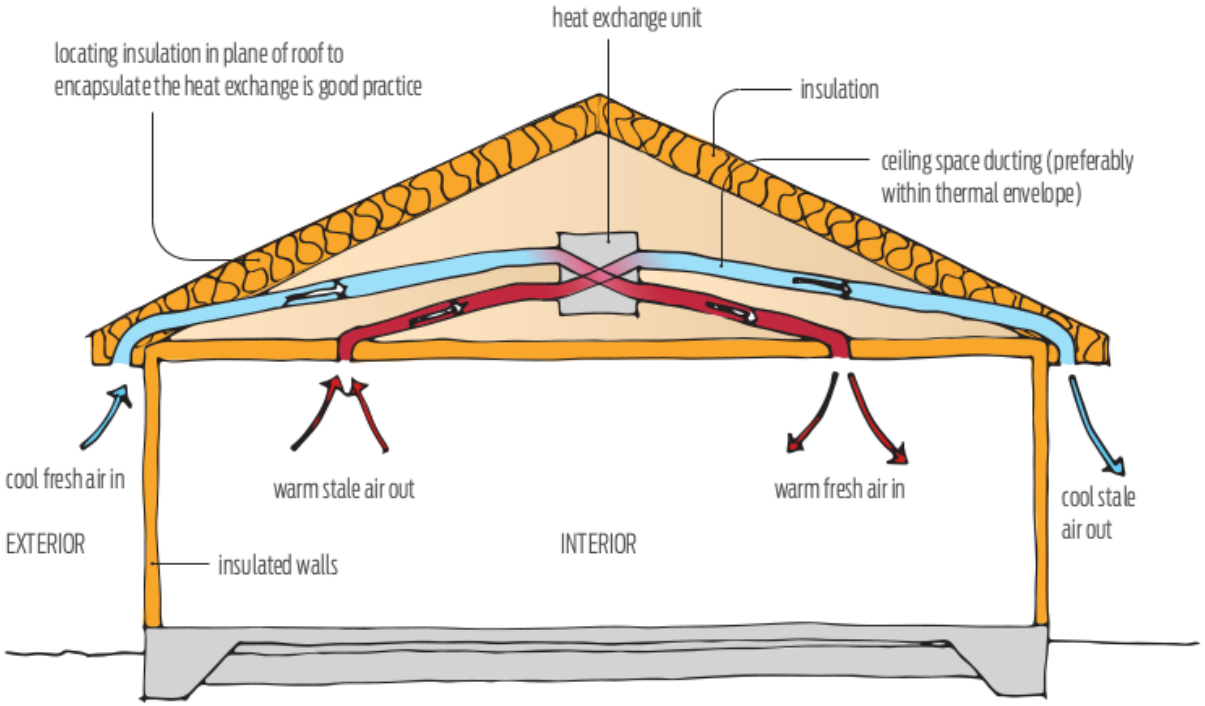
Internal ventilation

Poorly ventilated houses (with a large amount of excess internal moisture) increase the risk of moisture entering the roof space

Ensure there is adequate internal ventilation

Consideration should be given to incorporating effective supplementary mechanical ventilation



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Useful links

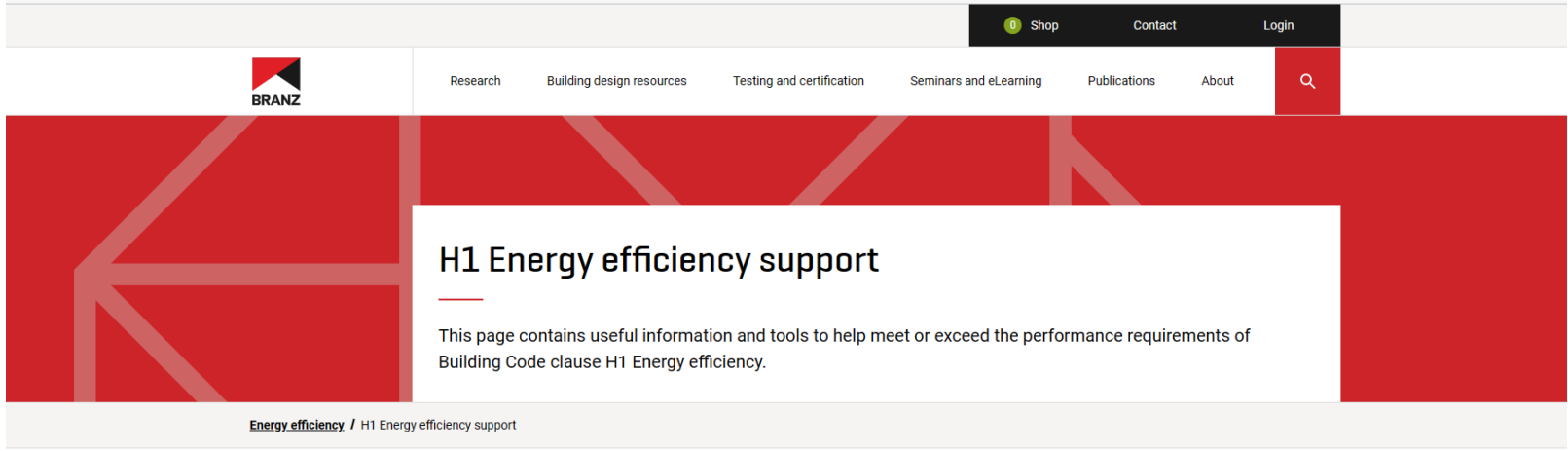
H1 *Energy efficiency* support

H1 Hub

H1 calculation method tool

House insulation guide

Previous H1 webinars



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Thanks

We really appreciate the effort you have made to attend

BRANZ webinar on H1 Floors coming in May 2023

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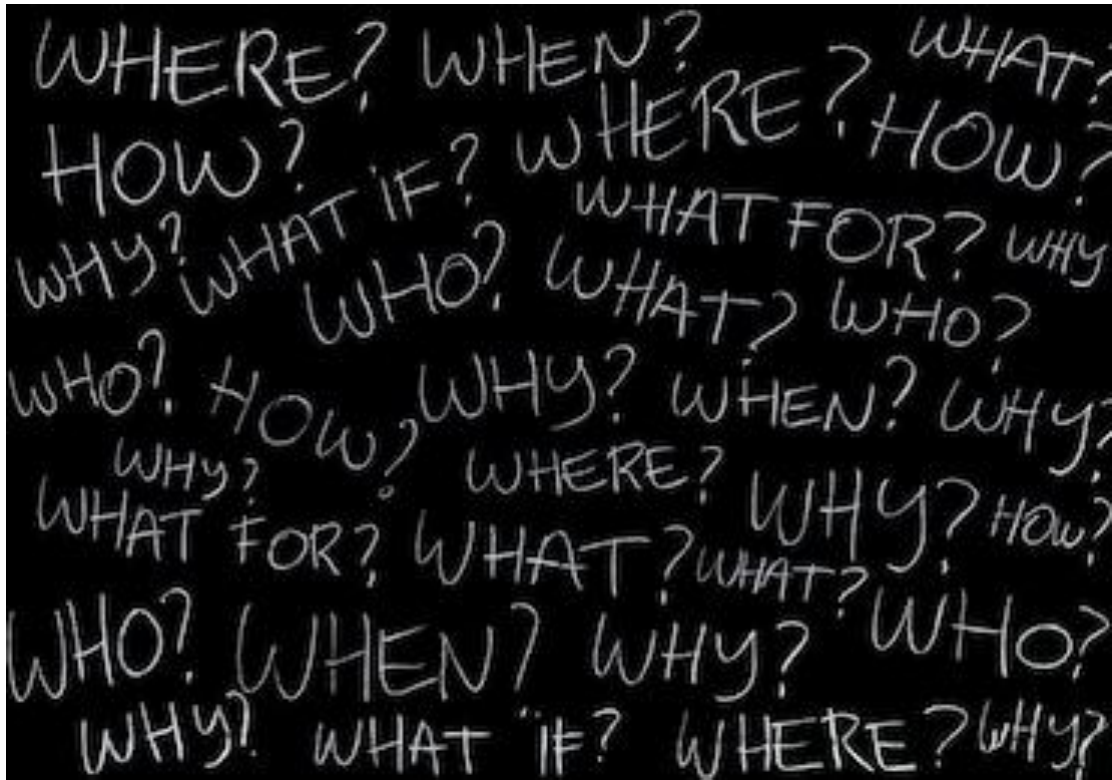
Questions

We are happy to take questions



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