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building science + bullsh*t seminar

H1 – Examples of compliant assemblies

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with Denise Martin & Peter Raimondo

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ACCEPTABLE SOLUTIONS

Who/what type of house is eligible for AS1?
(Schedule or Calculation method)

- Housing (detached dwelling, multi -unit dwellings, group dwellings)
- Other buildings with a floor area of occupied space up to 300m2 and
    - These buildings have either:
        - 30% or less glazing across the total wall area (or combined glazing across wall S,E,W, is less than 30% of that wall area)
        - Skylights no greater than 1.5m2 or 1.5% of total roof
        - Opaque door area is no greater than 6m2 or 6% of total roof
    - Or:
        - 40% or less glazing across the total wall area

ACCEPTABLE SOLUTIONS

How to show compliance for floors

- go to Table F1.2.1: in the H1/AS1 document

OR

- Calculate the floor R-Value and add the respective slab edge Psi Value to the perimeter length, examples can be found in the Passive House handbook.

ACCEPTABLE SOLUTIONS – FLOORS

- Acceptable construction systems
- Similar to windows – it depends on the slab size but

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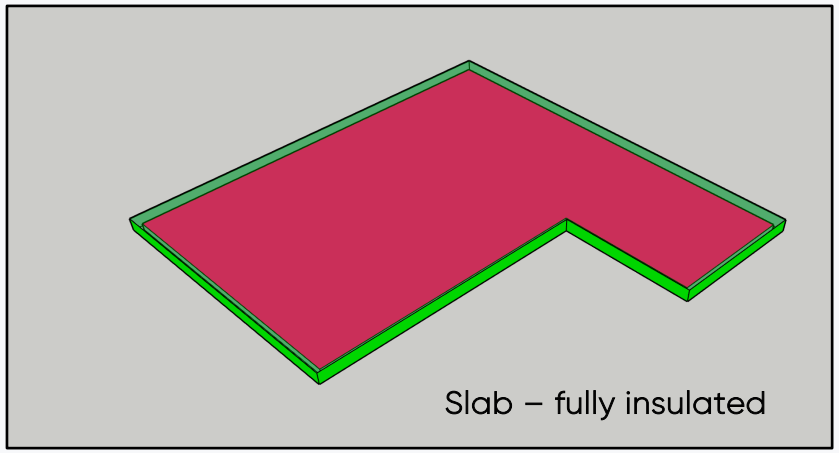
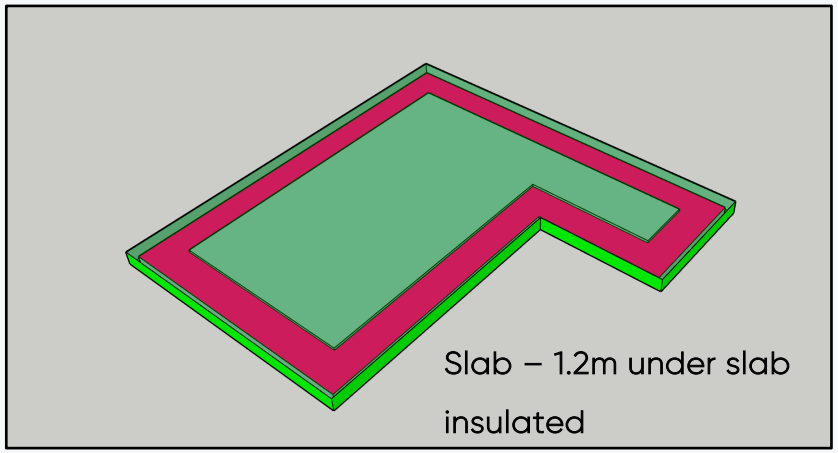
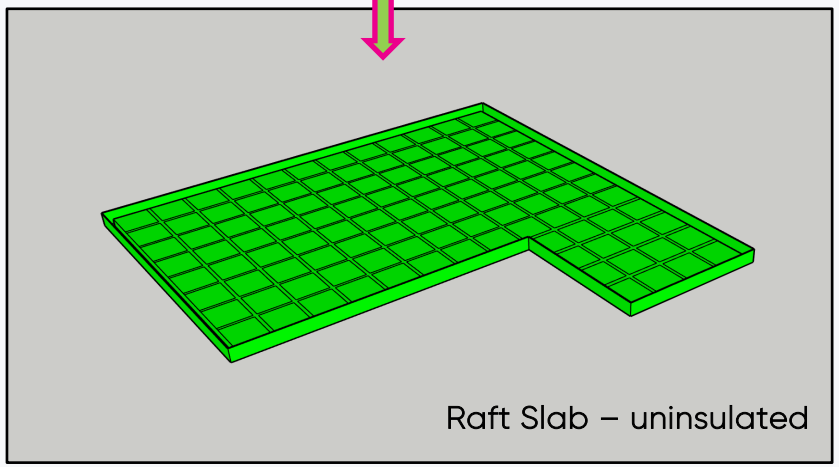
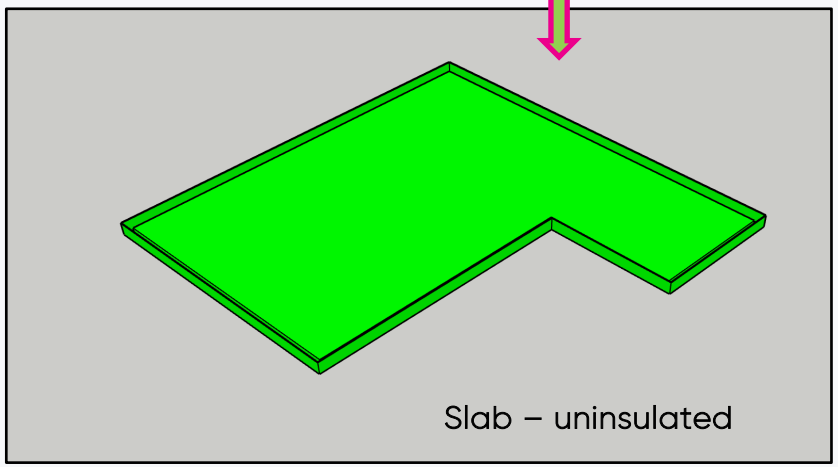
ALL THESE SLABS ARE COVERED IN H1/AS1 TABLES:





The same slabs with R1.0 edge insulation





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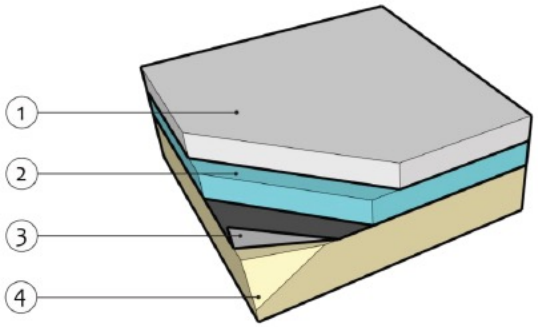
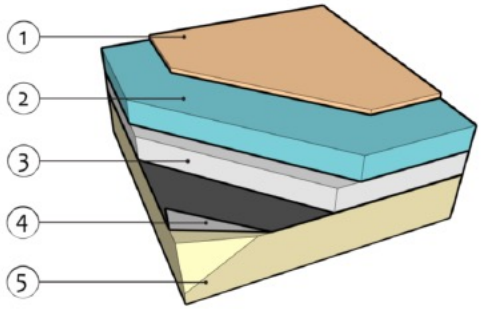
FLOOR EXAMPLES FROM PHINZ CONSTRUCTION DETAILS HANDBOOK



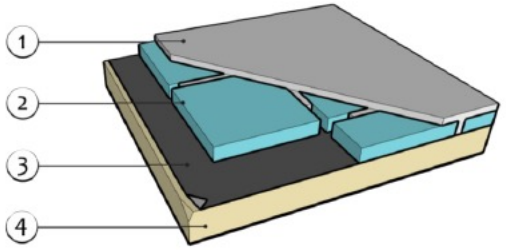
Insulated concrete slab on ground:

1. Concrete
2. Rigid insulation
3. DPM
4. Blinding and ground



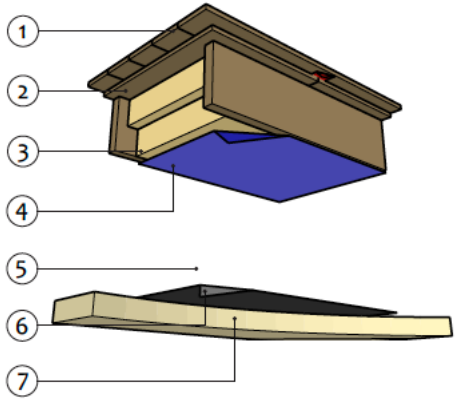
Top-insulated concrete slab on ground:

1. Subfloor plywood or timber panel (finish floor/carpet not shown)
2. Rigid insulation
3. Concrete
4. DPM
5. Blinding and ground



Concrete waffle pod slab:

1. Concrete slab and ribs
2. Foam pods (solid or hollow)
3. DPM
4. Blinding and ground



Suspended timber floor:

1. Interior finish floor timber or carpet (not included in cost/carbon)
2. Sub-floor timber panel or plywood junctions taped
3. Timber joists and fibre insulation
4. Windwash protection membrane (optional timber battens not shown)
5. Ventilated sub-floor space
6. DPM
7. Ground

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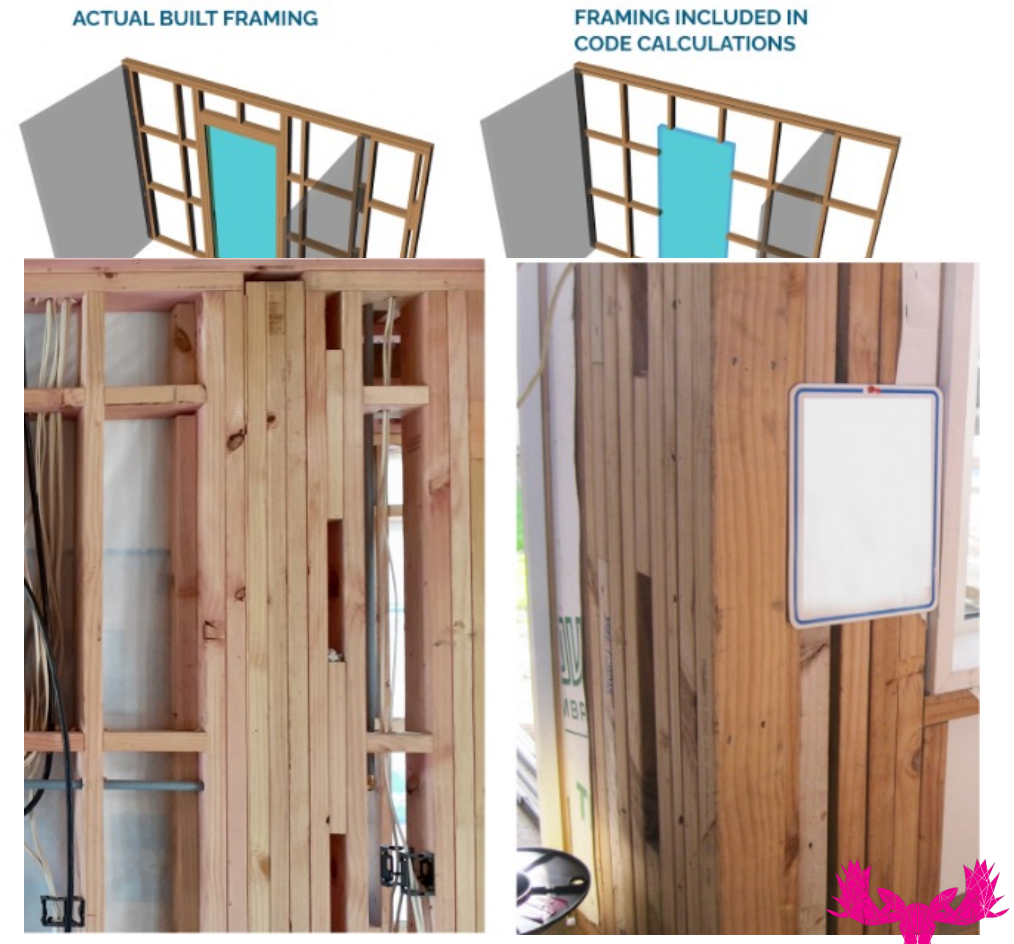
ACCEPTABLE SOLUTIONS

How to show compliance for walls & roofs

Calculate the R-Value as usual, but be aware that the percentage calculation for timber framing is grossly underestimating the real percentage of timber framing.

- Great article by sustainable engineering:
  '*Wall thermal performance is overestimated*'



ACCEPTABLE SOLUTIONS - WALLS

- 90mm timber frames walls – You can't just use R2.0 insulation!
- Due to thermal bridging R2.8 needed with 20% timber framing
- With metal studs thermal bridging is much worse and there will be a high risk of condensation inside the wall. Continuous exterior insulation ONLY.

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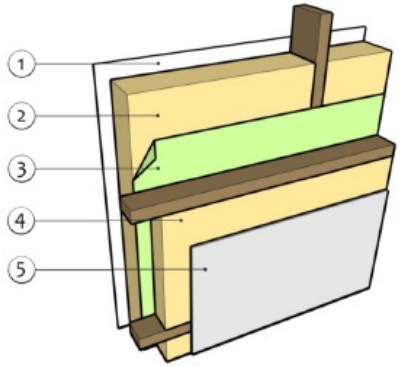
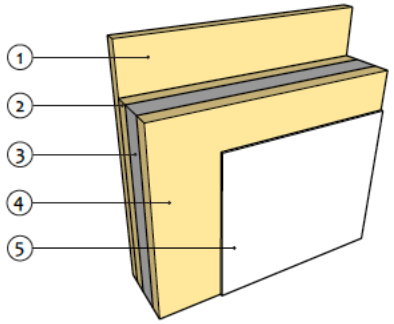
INTERESTING WALL EXAMPLES FROM PHINZ HANDBOOK AND OCULUS



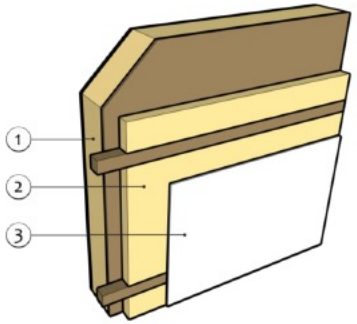
Timber wall:

1. Flexible underlay (WRB) or RAB
2. Structural stud layer with insulation and dwangs
3. Air/Vapour control layer (AVCL) membrane
4. Service cavity, insulated
5. Interior finish plasterboard



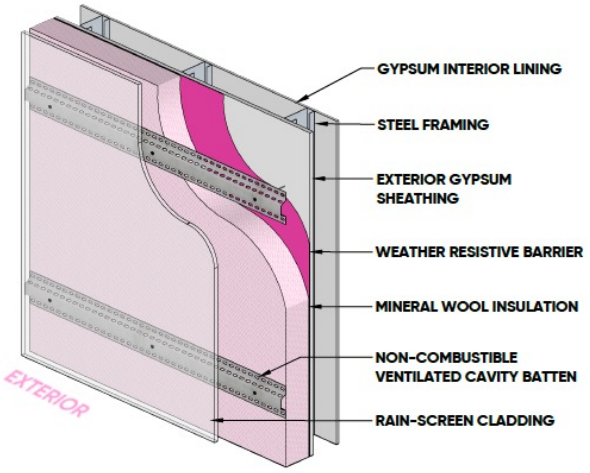
ICF wall:

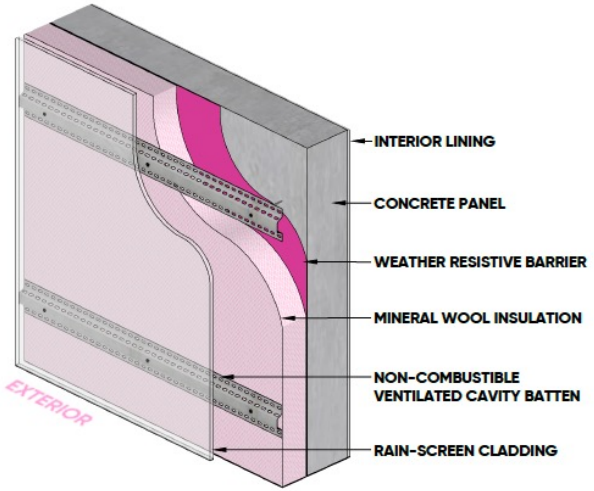
1. Optional additional external rigid insulation (exterior cementitious render not shown)
2. ICF block outer insulation layer
3. Reinforced concrete structural layer
4. ICF block internal insulation layer
5. Interior finish plaster or plasterboard.



SIP wall:

1. SIP panel junctions taped on inside (flexible wall underlay not shown)
2. Service cavity insulated
3. Interior finish plasterboard





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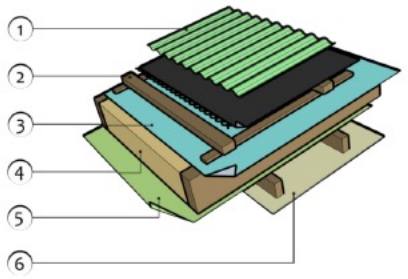
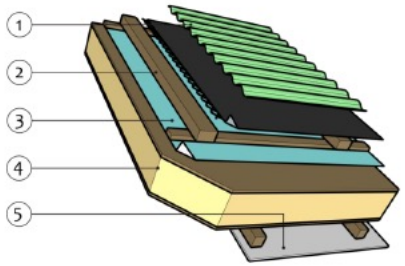
ROOF EXAMPLES FROM PHINZ CONSTRUCTION DETAILS HANDBOOK



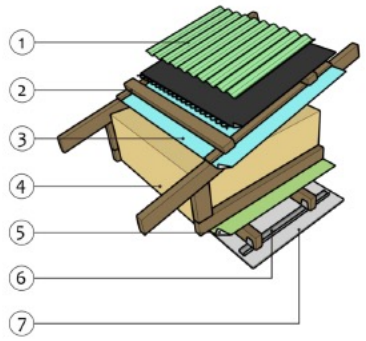
Skillion roof timber rafters:

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



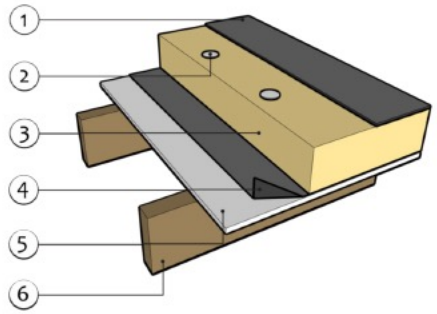
Skillion SIP roof

1. Roofing, underlay and safety mesh
2. Counter batten and purlin (ventilated)
3. Roof underlay vapour open membrane
4. SIP interior junctions taped for air/vapour control
5. Interior finish plasterboard with optional service cavity.



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 shown
7. Interior finish plasterboard



Membrane on rigid insulation warm roof:

1. Roof membrane (watertightness layer)
2. Mechanical fasteners (optional)
3. Rigid insulation
4. Air/vapour control membrane layer
5. Structural roof deck plywood shown (steel option)
6. Roof structure timber rafters shown (steel option)

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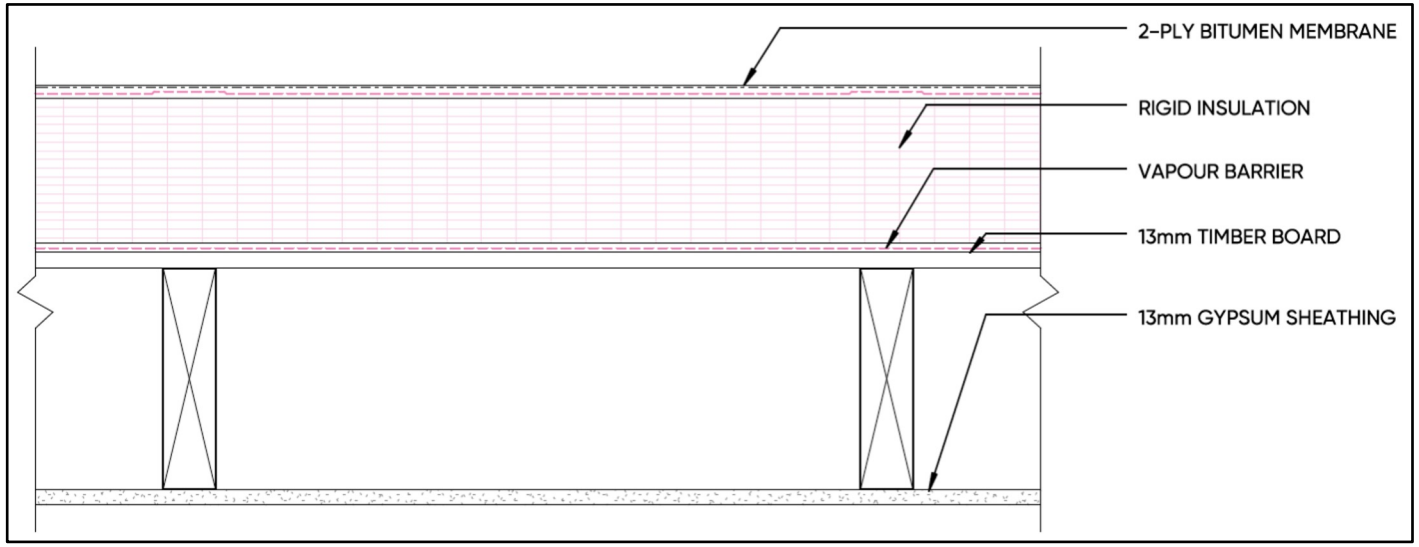
WHAT DOES AN R6.6 ROOF LOOK LIKE?

Because 300-400mm roofs are not an off the shelf product (yet), we have put a few options together that will get you where you need to be with a few adjustments to existing products.



Wooden Frame – Warm Roof

For all membrane roofs that have no mechanical fasteners (fully adhered), the new way to go is 120mm-240mm (depending on your rigid board insulation product - PIR being the thinnest option and EPS the thickest).

These roofs are great for 0-10º slopes, come with a vapour barrier, are airtight and usually allow plenty of space for services between the structural framing below! The structure here can be steel framing too, without thermal bridging being a problem, because the fully-external insulation keeps the framing warm and above the dew point temp.

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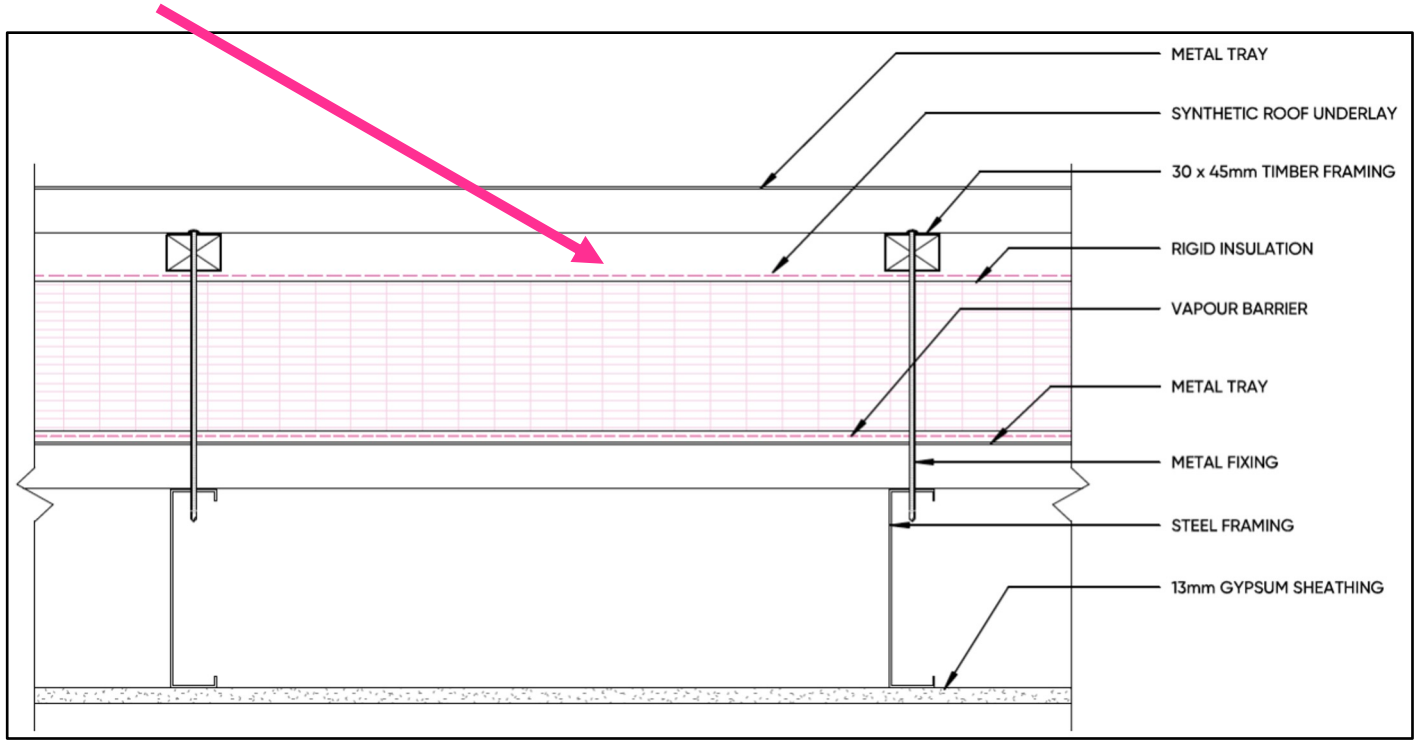
WHAT DOES AN R6.6 ROOF LOOK LIKE?

Metal tray roof systems can be trickier because they usually have metal fastener systems that connect the external roof through to the structure below. With the insulation being fixed mechanically, thermal bridging greatly reduces the total R-Value and insulation needs to increase to make up for it. This type of assembly will have condensation under the top metal tray on most cold days and nights, so drainage and adequate ventilation of that cavity is extremely important.



Metal Frame – Warm Roof

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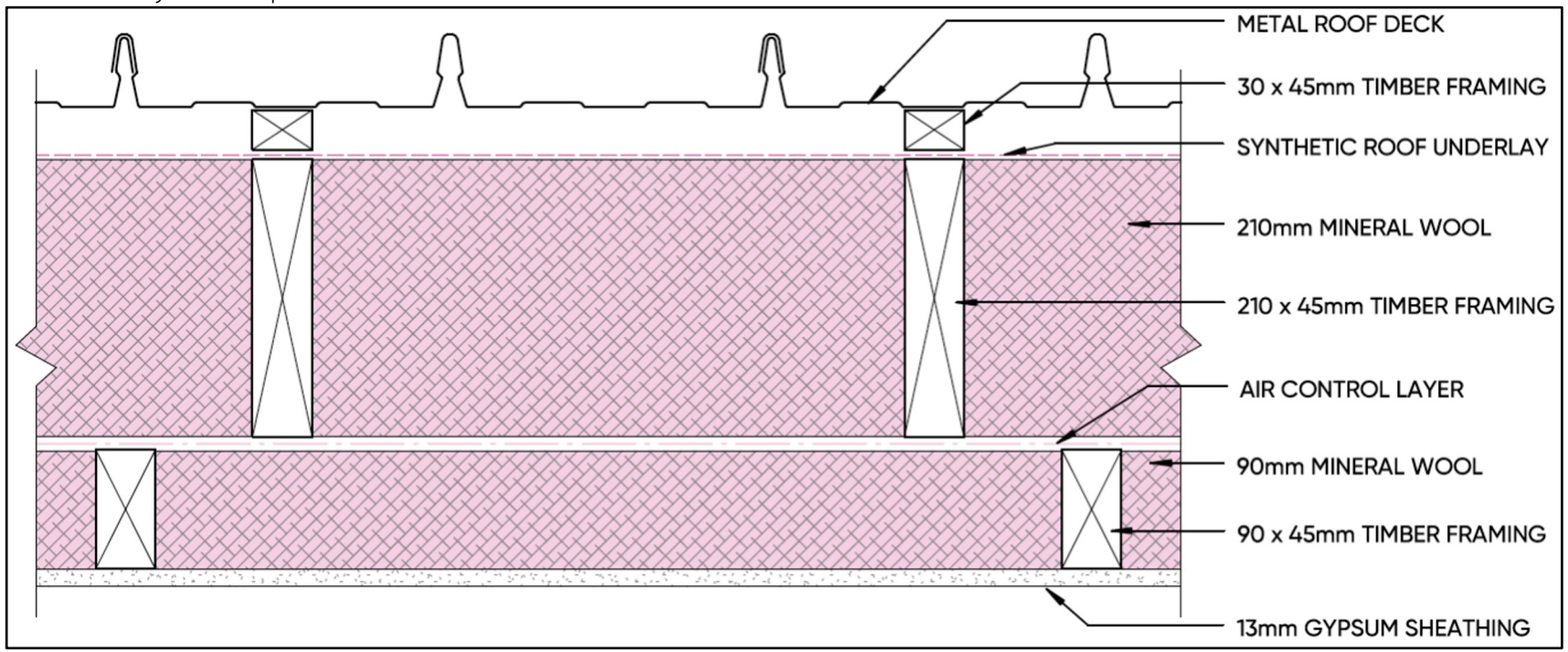
WHAT DOES AN R6.6 ROOF LOOK LIKE?

Standard "cold roofs" can be constructed using a split approach where the main rafter space is insulated as usual, and an internal insulation layer is added in a separate layer. This allows the insulation being uninterrupted across the main area while the internal framing provides space for internal services (great approach for walls, too). The separation of the layers also allows for the use of an air control layer which is important for moisture management. Also, good for roofs down to 3º slopes. Because of the thermal bridging of the framing, the interior air control layer is required for condensation control.



Wooden Frame – Cold Roof 210 + 90mm Framing

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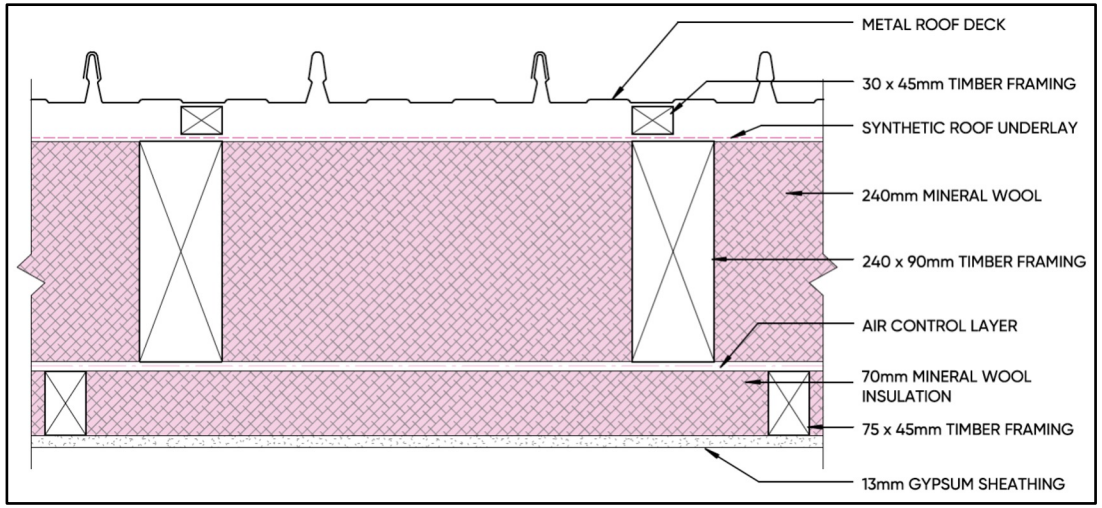
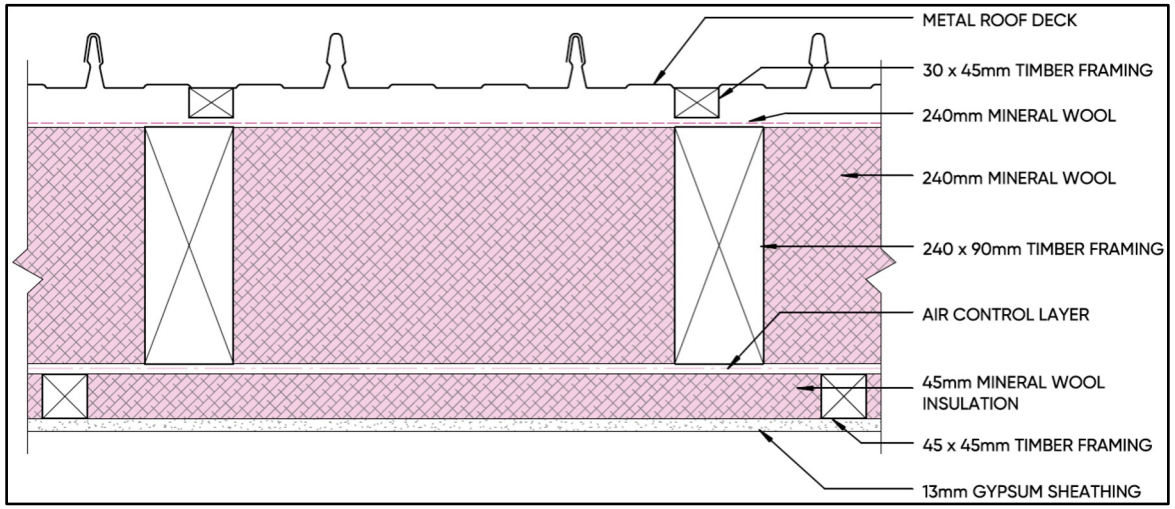
WHAT DOES AN R6.6 ROOF LOOK LIKE?

If you have bigger framing depth you can reduce the internal cavity size accordingly, but notice that the air control layer always remains.



Wooden Frame – Cold Roof 240 + 90mm Framing



Wooden Frame – Cold Roof 240 + 45mm Framing

ACCEPTABLE SOLUTIONS

How to show compliance for windows

- Leave it to the suppliers….

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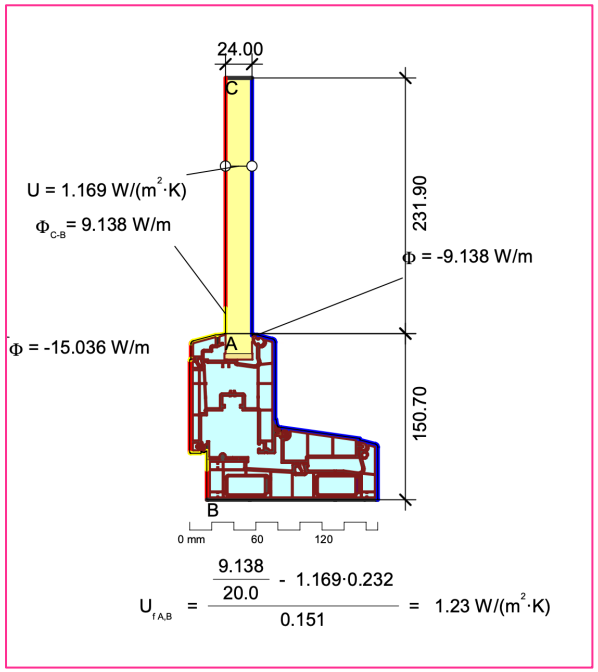
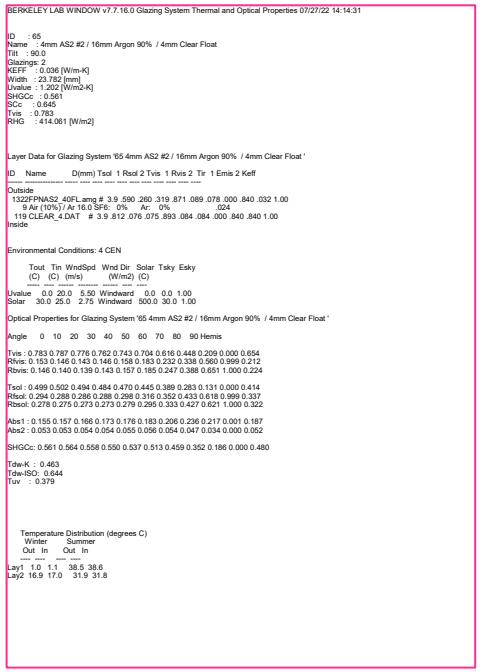
ACCEPTABLE SOLUTIONS - WINDOWS

Or show this:



frame



BERKELEY LAB WINDOW v7.7.16.0 Glazing System Thermal and Optical Properties 07/27/22 14:14:31

ID : 65
Name : 4mm AS2 #2 / 16mm Argon 90% / 4mm Clear Float
Tilt : 90.0
Glazings: 2
KEFF : 0.036 [W/m-K]
Width : 23.782 [mm]
Uvalue : 1.202 [W/m2-K]
SHGCc : 0.561
SCc : 0.645
Tvis : 0.783
RHG : 414.061 [W/m2]

Layer Data for Glazing System '65 4mm AS2 #2 / 16mm Argon 90% / 4mm Clear Float '

ID Name D(mm) Tsol 1 Rsol 2 Tvis 1 Rvis 2 Tir 1 Emis 2 Keff

Outside
1322FPNAS2_40FL.amg # 3.9 .590 .260 .319 .871 .089 .078 .000 .840 .032 1.00
9 Air (10%)? Ar 16.0 SF6: 0% Ar: 0% .024
119 CLEAR_4.DAT # 3.9 .812 .076 .075 .893 .084 .084 .000 .840 .840 1.00
Inside

Environmental Conditions: 4 CEN

Tout Tin WndSpd Wnd Dir Solar Tsky Esky
(C) (C) (m/s) (W/m2) (C)

Uvalue 0.0 20.0 5.50 Windward 0.0 0.0 1.00
Solar 30.0 25.0 2.75 Windward 500.0 30.0 1.00

Optical Properties for Glazing System '65 4mm AS2 #2 / 16mm Argon 90% / 4mm Clear Float '

Angle 0 10 20 30 40 50 60 70 80 90 Hemis

Tvis : 0.783 0.787 0.776 0.762 0.743 0.704 0.616 0.448 0.209 0.000 0.654
Rfvis: 0.153 0.146 0.143 0.146 0.158 0.183 0.232 0.338 0.580 0.999 0.212
Rbvis: 0.146 0.140 0.139 0.143 0.157 0.185 0.247 0.388 0.651 1.000 0.224

Tsol : 0.499 0.502 0.494 0.484 0.470 0.445 0.389 0.283 0.131 0.000 0.414
Rfsol: 0.294 0.288 0.286 0.288 0.298 0.316 0.352 0.433 0.618 0.999 0.337
Rbsol: 0.278 0.275 0.273 0.273 0.279 0.295 0.333 0.427 0.621 1.000 0.322

Abs1 : 0.155 0.157 0.166 0.173 0.176 0.183 0.206 0.236 0.217 0.001 0.187
Abs2 : 0.053 0.053 0.054 0.054 0.055 0.056 0.054 0.047 0.034 0.000 0.052

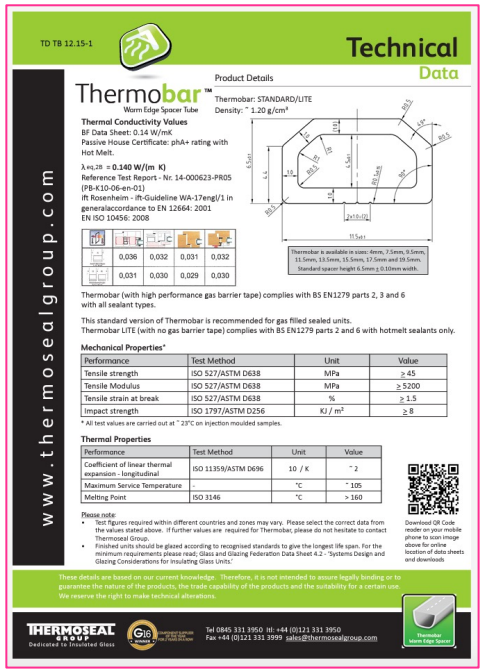
SHGCc: 0.561 0.564 0.558 0.550 0.537 0.513 0.459 0.352 0.186 0.000 0.480

Tdw-K : 0.463
Tdw-ISO: 0.644
Tuv : 0.379

Temperature Distribution (degrees C)
Winter Summer
Out In Out In

Lay1 1.0 1.1 38.5 38.6
Lay2 16.9 17.0 31.9 31.8

glass



TD TB 12.15-1

Technical Data

Thermobar™
Warm Edge Spacer Tube

Product Details
Thermobar: STANDARD/LITE
Density: ~ 1.20 g/cm³

Thermal Conductivity Values
BF Data Sheet: 0.14 W/mK
Passive House Certificate: phA+ rating with Hot Melt.
λ eq,2ft = 0.140 W/(m K)
Reference Test Reports - Nr. 14-000623-PR05 (PB-K10-06-en-01)
ift Rosenheim - ift-Guideline WA-17engl/1 in generalaccordance to EN 12664: 2001
EN ISO 10456: 2008

	0,036	0,032	0,031	0,032
	0,031	0,030	0,029	0,030

Thermobar is available in sizes: 4mm, 7.5mm, 9.5mm, 11.5mm, 13.5mm, 15.5mm, 17.5mm and 19.5mm. Standard spacer height 6.5mm ± 0.10mm width.

Thermobar (with high performance gas barrier tape) complies with BS EN1279 parts 2, 3 and 6 with all sealant types.

This standard version of Thermobar is recommended for gas filled sealed units.
Thermobar LITE (with no gas barrier tape) complies with BS EN1279 parts 2 and 6 with hotmelt sealants only.

Mechanical Properties*

Performance	Test Method	Unit	Value
Tensile strength	ISO 527/ASTM D638	MPa	≥ 45
Tensile Modulus	ISO 527/ASTM D638	MPa	≥ 5200
Tensile strain at break	ISO 527/ASTM D638	%	≥ 1.5
Impact strength	ISO 1797/ASTM D256	KJ / m²	≥ 8

* All test values are carried out at ~ 23°C on injection moulded samples.

Thermal Properties

Performance	Test Method	Unit	Value
Coefficient of linear thermal expansion - longitudinal	ISO 11359/ASTM D696	10 / K	~ 2
Maximum Service Temperature	-	°C	~ 105
Melting Point	ISO 3146	°C	> 160

Please note:
- Test figures required within different countries and zones may vary. Please select the correct data from the values stated above. If further values are required for Thermobar, please do not hesitate to contact Thermoseal Group.
- Finished units should be glazed according to recognised standards to give the longest life span. For the minimum requirements please read; Glass and Glazing Federation Data Sheet 4.2 - 'Systems Design and Glazing Considerations for Insulating Glass Units.'

Download QR Code reader on your mobile phone to scan image above for online location of data sheets and downloads

These details are based on our current knowledge. Therefore, it is not intended to assure legally binding or to guarantee the nature of the products, the trade capability of the products and the suitability for a certain use. We reserve the right to make technical alterations.

THERMOSEAL GROUP Dedicated to Insulated Glass

Tel 0845 331 3950 Intl: +44 (0)121 331 3950
Fax +44 (0)121 331 3959 sales@thermosealgroup.com

www.thermosealgroup.com

spacer

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ACCEPTABLE SOLUTIONS - WINDOWS

Acceptable construction systems

- Hard to define because even using the same frame and glass will lead to different R-Values for two different sized windows!
- If using the standard size window (NZS4211, old version) as a reference it is technically impossible to use non thermally broken frames.
- So at a minimum use thermally broken frames, non metal glass edge spacer, Low E coating, and glass with a gas filling (argon, krypton, xenon)

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ACCEPTABLE SOLUTIONS

Difference between AS1 and AS2

- AS1 is for housing and for small buildings (below 300m2)
- AS2 is for anything else

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
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

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	R3.5	R4.0	R5.0	R5.4	R6.0	R7.0
Wall	R2.2	R2.4	R2.7	R3.0	R3.0	R3.2
Floor	R2.2	R2.2	R2.2	R2.4	R2.5	R2.6
Windows and doors	R0.33	R0.33	R0.37	R0.37	R0.40	R0.42
Skylights	R0.42	R0.42	R0.46	R0.46	R0.49	R0.51

VERIFICATION METHOD VM1

1. Who/what type of house is eligible for VM1?

ALL HOUSING of any size and all glazing area

VERIFICATION METHOD VM1

2. How to show compliance

Model the building geometry according to Appendix D using appropriate software.

Cheapest/fastest way to do is is PHPP and designPH in sketchup, but can be done using NZGBC ECCHO (If you've done the Homestar Designer course) or another modelling software that is built according to ANSI/ASHRAE Standard 140

VERIFICATION METHOD VM1

3. Reference model

Save a copy of your original model and assign the construction R-Values from table 2.1.2.2B from AS1 to the building and compare the difference

But make sure you are clear on the other data inputs for the model, such as internal heat load profiles, ventilation, building airtightness (PHPP) shading, heating and cooling systems.

DIFFERENCE BETWEEN VM1 AND VM2

- VM1 is for housing and for small buildings (below 300m2)
- VM2 is for anything else

They work the same way!

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Q&A

H1 – EXAMPLES OF COMPLIANT ASSEMBLIES

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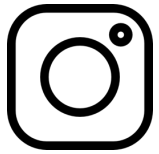
OCTOBER
26/10/23
Best practice for upgrading existing roofs

NOVEMBER
30/11/23
How to keep your house cool

*subject to change!

OCULUS

MORE INFORMATION?



@pink.moose

Oculus Architectural Engineering Ltd

www.oculusltd.co.nz (H1 page, Q&A, Resources, Podcast)

Next Building Science + Bullsh*t Seminar: 27/04/2023 - H1 – Costing - No, it doesn't cost more!