warm|shell

Warmshell Roof

Design Guide & Installation Details

Contents

Introduction

Warmshell Roof offers a complete, comprehensive method for insulating roofs with our universal Warmshell Woodfibre Boards, suitable for roofs as well as internal and external wall insulation. This guide shows design principles for an integrated approach to warm and dry retrofit.

Key benefits of installing Warmshell:

- Warmer Houses
- Reduces Summer Overheating
- Better than Zero Carbon Building
- High Real-World Performance

Warmshell Woodfibre insulation boards offer the optimum way to insulate a roof, old or new. Our boards are a renewable insulation made with sawmill waste, from wood grown in sustainably managed forests. What makes Warmshell Woodfibre the truly long term sustainable option is that it locks up carbon during its manufacture – each 1m³ of Warmshell Woodfibre stores 322kg of CO_2, even allowing for energy input during the production process – it's the answer for better than zero carbon building.

Woodfibre is an especially useful insulation for roofing, as it not only protects from the cold, but is far superior to other types of insulation in preventing summer overheating. Warmshell Woodfibre has a much higher density than mineral wool but the same ability to insulate, which means it has much better thermal inertia or 'decrement delay', so the heat of the summer sun doesn't travel through to the room as quickly.

With the tongue and groove profile and wet plastering, our build ups are designed to achieve real-world performance that you can rely on. Many synthetic insulation systems have a massive energy performance gap between the predicted "as designed" U value and what is really achieved "as built" on site. Using foil backed plastic insulation can lead to a U value worse than predicted – mainly due to focusing on tick box computer exercises, instead of materials which can be installed in a practical manner in the real world.

Components

Exactly what materials you will need in a roof will vary, especially with retrofit where the possibilities are almost endless, but here are key materials for most jobs:

Warmshell Woodfibre Boards
Rigid boards with tongue and groove, these are our universal option for walls and roofing, inside or out. They are suitable for plastering and rendering where needed.

Solo® One Coat Lime Plaster
For direct plastering of Warmshell Woodfibre, Solo Plaster can also be applied over plasterboard or woodwool.

Flexible Insulation
Pavaflex or Pavatextil semi-compressible insulation batts are ideal for fitting between rafters, with no risk of gaps or slumping.

Air-tight tapes
Air-tight tapes are vital for sealing junctions and penetrations through the insulation - as the insulation zone gets thicker it becomes more and more important to ensure air isn't leaking through these areas. They can help maintain the continuity of the *air barrier* or the *wind barrier*. Options include Proclima Contega Solido SL and Siga Fentrim - some can be plastered over too.

Wind Barrier
On the cold side of the insulation, the wind barrier stops cold air blowing through air gaps or infiltrating the pore structure causing sudden temperature drops. Warmshell Woodfibre Boards can act as a wind barrier in their own right, due to their dense surface.

> Breather Membrane
The most common type of wind barrier in recent times, breather membranes let moisture vapour escape easily while keeping wind out, and act as a second line of defence against rain or snow blowing under tiles.

> Bitumen Felt
A commonly found non-breathable material, for which a ventilated gap must be left between bitumen felt and any newly installed insulation.

Air Barrier
An air barrier is a generic term for a layer which stops rapid movement of air and drafts into and through the insulation or any small gaps in it. Air barriers can take many forms, from traditional torching to lime plaster, to modern high-performance membranes.

> Vapour Control Layer
A Vapour Control Layer (VCL) is a gas-tight membrane which (in theory at least) stops warm damp air inside the house migrating into the insulation zone. Other materials may also act as VCLs, for instance glazed tiles or foil-backed insulation - this can be counterproductive in the wrong location.

> Intelligent Membrane
A special membrane which can vary its water vapour diffusion resistance (SD-Value), so it is more like a breather-membrane in certain moisture conditions and switches to a VCL in others. Intelligent membranes such as Proclima Intello or Pro Clima DB+ can optimise the drying conditions in the roof across the seasons.

Ejot STR-H
Insulated screw fixings, to be used with Warmshell Woodfibre Boards where they will be plastered over afterwards with Solo® One Coat Lime Plaster.

Rafter Screws
Specialist Screws used where the Warmshell Woodfibre Board is clamped between the rafter and a batten. Various options are available such as Heco Topic Plus Therm, or options from Spax or Ejot. The manufacturer will have calculation software to provide the required fixing specification for your specific roof design.

Expanding Foam Tape
Expanding foam tape is suitable for permanently flexible junctions between rigid woodfibre and masonry, to ensure no air bypass and to minimise thermal bridging. Used where a board cannot be scribed to the wall perfectly.

Airtight Grommets for Penetrations
These adhesive patches stop air leakage and draughts around pipes and penetrations. Air leakage makes insulation ineffective and can cause condensation. Examples are Proclima Kaflex and Roflex.

Proprietary Eaves Ventilation
Used to prevent the insulation from blocking ventilation into the roof space. Install ventilation spacers such as Proprietary Eaves Ventilation Trays for roofs accessible from above, and Refurbishment Ventilation Panels when insulating from within the roof space.

Design Principles

Insulation doesn't just have to keep the occupants warm, it also must be designed in a way that keeps the building and its occupants dry and healthy. Installing insulation into a building in a North European climate introduces moisture risks and reduces air quality – but using natural, hygroscopic materials and good detailing can help control those risks for a warm, healthy house.

The advice and detailing given in this document is generic and based on the UK climate and typical housing stock.

This should be read in conjunction with the following documents:

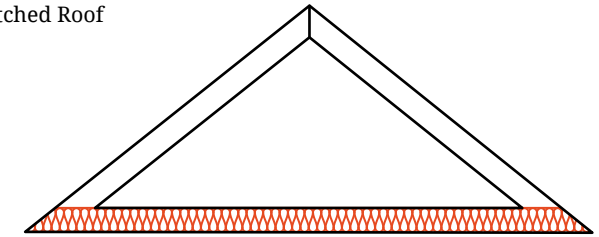
- BS5250 Management of Moisture in Buildings – Code of Practice
- Retrofit Room in Roof Insulation Guide to Best Practice
- The Building Regulations Approved Documents, Technical Handbooks in Scotland or Technical Booklets in Northern Ireland

The details given may not be appropriate for all situations such as swimming pools, air-conditioned buildings or where other uncommon conditions are found, especially where large amounts of moisture are generated internally.

This guide does not provide advice for flat roofs with woodfibre; while this is possible the design can become significantly more complex.

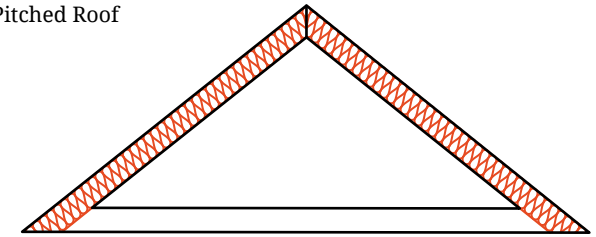
Insulation in a pitched roof can be located in three ways:

1) Cold Pitched Roof



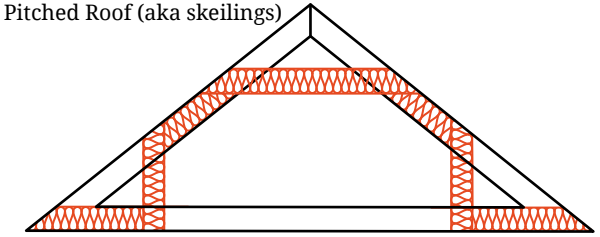
Insulation follows the line of the horizontal ceiling.

2) Warm Pitched Roof



Insulation follows the slope of the roof.

3) Hybrid Pitched Roof (aka skeilings)



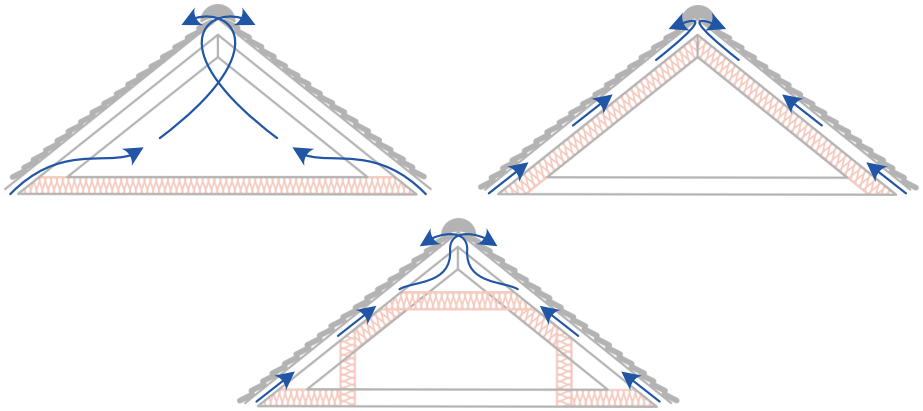
Insulation follows horizontal, vertical and the slope of the roof.

When designing, some key principles should be considered and clearly marked on the plans at the start:

- The location of the air barrier (this may be Solo One Coat Lime Plaster, a VCL or an intelligent membrane depending on the design).
- The location of the thermal zone, ensuring it is as continuous as possible.
- The location of the ventilation zone (and wind barrier when required) and ensure it is adequate to deal with predicted condensation.
- The location of where services will run. Avoid penetrations through the air barrier wherever possible, and detail robust airtight solutions where penetrations cannot be avoided.

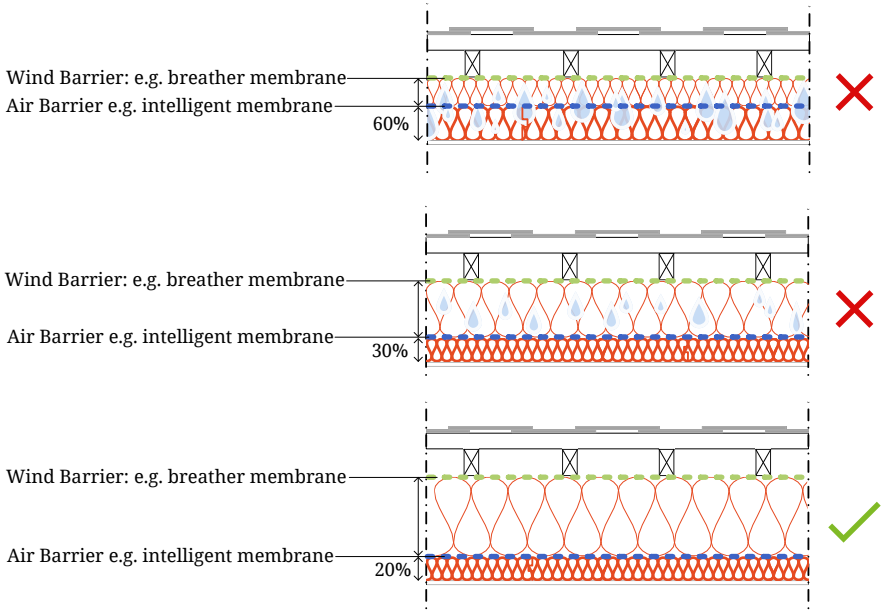
In every design, it is vital that moisture can easily evaporate on the cold side of the insulation, by the means of ventilation using plenty of outside air. Detailing adequate ventilation in the correct zone is a crucial part of any design process. A condensation risk analysis should be carried out; this may be done with WUFI or with BS 13788 (it is worth noting the latter is too simplistic to assess moisture with solid wall insulation, as it fails to consider the impact of driving rain and leaks on porous bricks, but because the conditions in a roof are much simpler to model it is an acceptable approach for roofs in normal domestic dwellings). Information on the surface area of ventilation openings required for different scenarios and minimum depths of ventilation zones are given in detail in BS5250.

Continuous, unobstructed ventilation from the eaves to the ridge.



As a general rule, the material with the highest vapour resistance must be on or near the warm side, and the material with the lowest vapour resistance should be on the cold side. Membranes are popular as they make following this principle simple, but it can also be achieved without using membranes. Where membranes are used, they must be installed without gaps or tears, and should be bonded at the edges to the walls.

Intelligent membranes should only be installed at most 20% of the way through the insulation zone from the internal face (warm side) of the insulation.



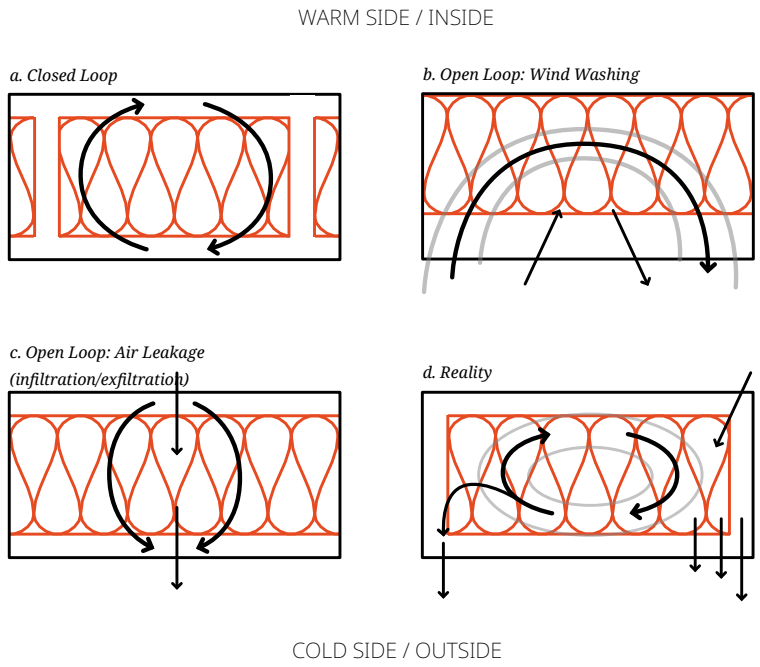
Retrofitting insulation to an existing roof where the tiles are not being re-laid requires careful inspection. Bitumen felt and some other types of underlay may not be breathable, in which case the ventilation strategy must be altered to allow ventilation underneath the felt (see detail ROOF 001), rather than across the top, as is more common.

Indoor ventilation should be considered at the design stage. Making the roof more airtight brings significant benefits in energy savings, but will also increase the moisture risk if not designed for. Consideration should be given to MVHR or individual room ventilation.

As with all insulation, avoiding thermal bypass is crucial for good performance and a reduced energy performance gap. Currently, the focus in the Building Regulations and mainstream construction is far too heavily weighted on the quantity of insulation installed, rather than the quality of insulation and detailing. In fact, quality of installation should be the starting point, and only once this is optimised should low U-values be targeted.

Even small cracks and gaps can cause a significant drop in performance as shown in the study below by the Passivhaus Trust* - this is why Warmshell Woodfibre tongue and groove boards, and compression fit insulation can be superior to many other types of insulation, because they are designed to be practical to install in the real world.

Types of thermal bypass



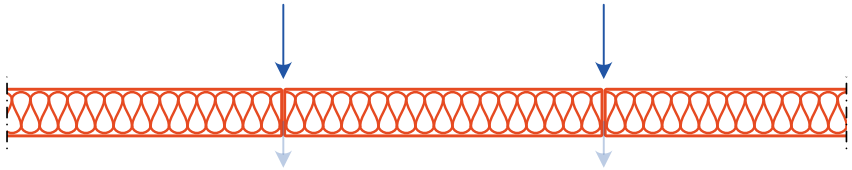
*Passivhaus Trust 'Thermal Bypass Risks - A Technical Review' September 2022

Width of air gap	Notional U-value (W/m².K)	Thermal bypass (W/m².K)	Ef ective U-value (W/m².K)	Proportional increase
2mm	*0.210**	0.025	0.235	***12%****
	0.150	0.025	0.175	**17%**
	0.100	0.025	0.125	**25%**
7.5mm	*0.210**	0.216	0.426	***203%****
	0.150	0.216	0.366	**244%**
	0.100	0.216	0.316	**316%**
15mm	*0.210**	0.882	1.092	***520%****
	0.150	0.882	1.032	**688%**
	0.100	0.882	0.982	**982%**

Table 1: *Extrapolated heat losses for various U-values, based on Hens and Carmeliet (2001) (*original data shown in italics)*

Insulation should be as continuous as possible - Warmshell Woodfibre Boards applied over or under a rafter can have a disproportionate benefit even with just 40mm by eliminating the cold bridge effect of each rafter while improving airtightness. This is enhanced by the boards' tongue and groove profile. The air barrier on the warm side, whether this is Solo® One Coat Lime Plaster or a membrane, should also be continuous.

Warmshell Woodfibre Boards' tongue and groove profile increase airtightness levels.



Woodfibre insulation boards without a tongue and groove have increased levels of thermal bypass.

Pre-installation Survey

When insulation is being retrofitted to a roof, it is important to carefully inspect the existing condition of the roof, checking for signs of moisture problems (mould or rot), which must be rectified before insulation is installed.

It is also vital to correctly identify any existing membranes or vapour barriers that will be left in place to ensure they are compatible with the chosen ventilation strategy.

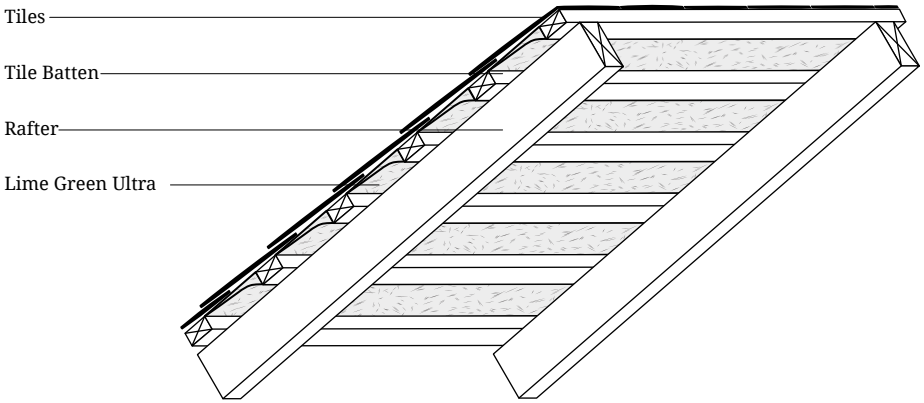
Further information on conducting a pre-installation survey can be found in the Government Best Practice Guidance to Retrofit Room in Roof Insulation.

Retrofit Room in Roof Insulation: Guide to Best Practice
(publishing.service.gov.uk)

Torching with Ultra

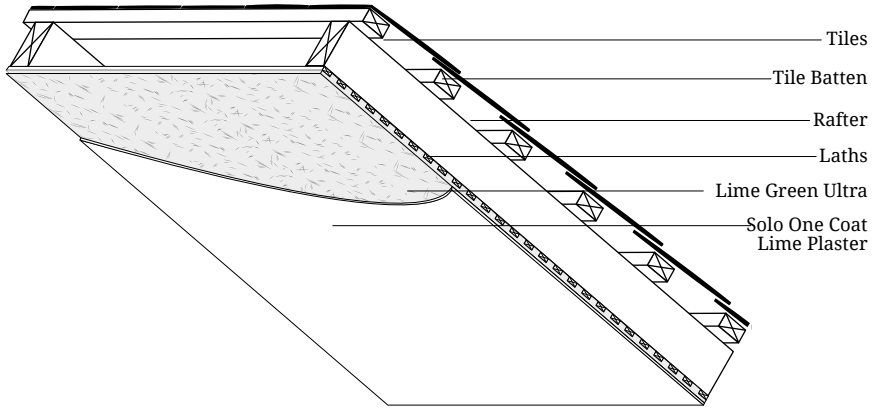
Torching is a traditional method of making a roof warmer and more wind-tight, by applying a sticky lime plaster to the underside of tiles.

Torching only offers a very limited gain in U values, but the reduction in air leakage under tiles can make a noticeable improvement. Because there is so much air circulation from the inside, there is no need for vapour barriers or similar membranes.

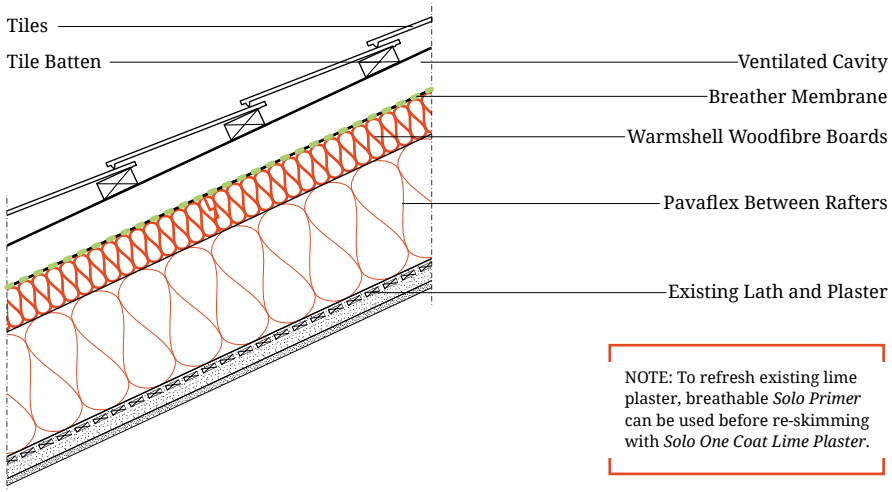


Plastering Laths with Ultra

Existing laths can be renewed with Lime Green Ultra and Solo One Coat Lime Plaster.



To retain the ceiling finish, insulation can be installed above the lath and plaster ceiling.

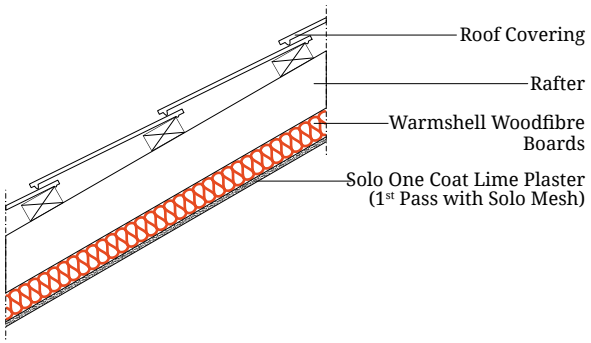


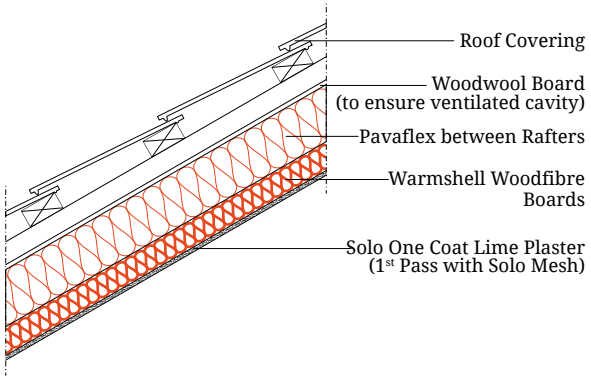
NOTE: To refresh existing lime plaster, breathable *Solo Primer* can be used before re-skimming with *Solo One Coat Lime Plaster*.

Principles of Installing Warmshell Woodfibre Boards

Warmshell Woodfibre Boards are best installed either above or below rafters. For optimal installation of insulation in-between rafters, Pavaflex or Pavatextil cut slightly larger than required will ensure a good friction fit. Please note: no membranes are shown in these illustrations, but may be required depending on the precise design. Please contact us for further information.

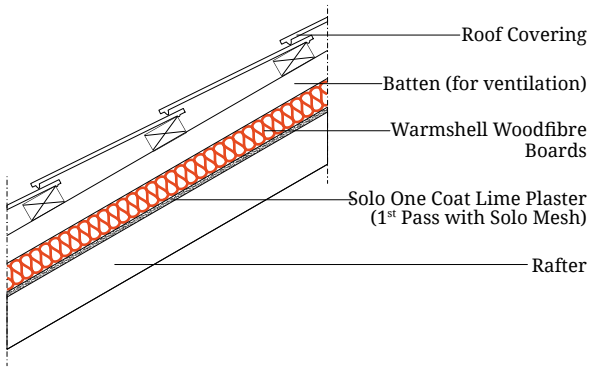
access from below

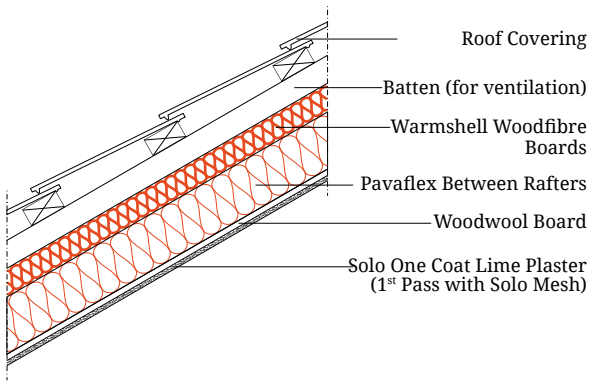




- Roof height does not need to be visibly increased
- Tongue and groove reduces gaps and unwanted air infiltration and allows for continuous insulation
- Easier access and can be installed without stripping roof coverings

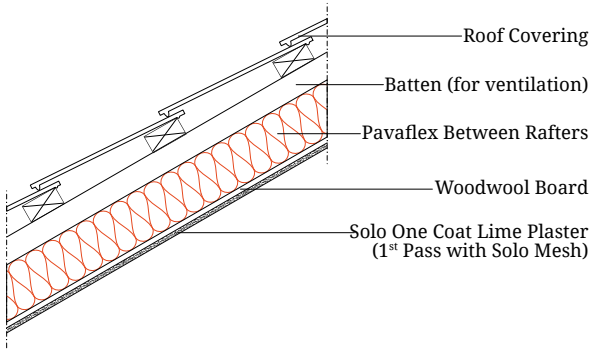
access from above

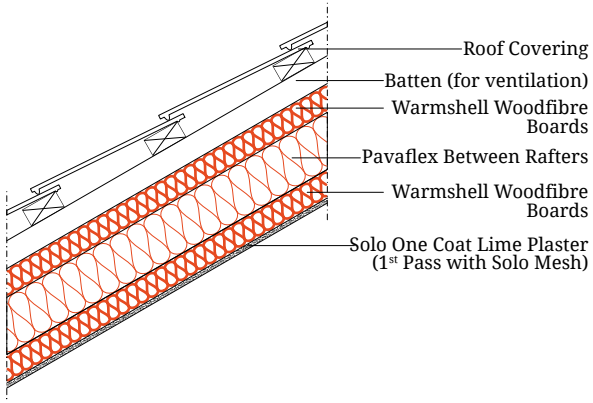




- Historic ceilings can be retained
- Reduces heat loss, thermal bridging and overheating
- Tongue and groove reduces gaps and unwanted air infiltration
- Keeps the structure on the warm, dry side of the insulation

access from above and below





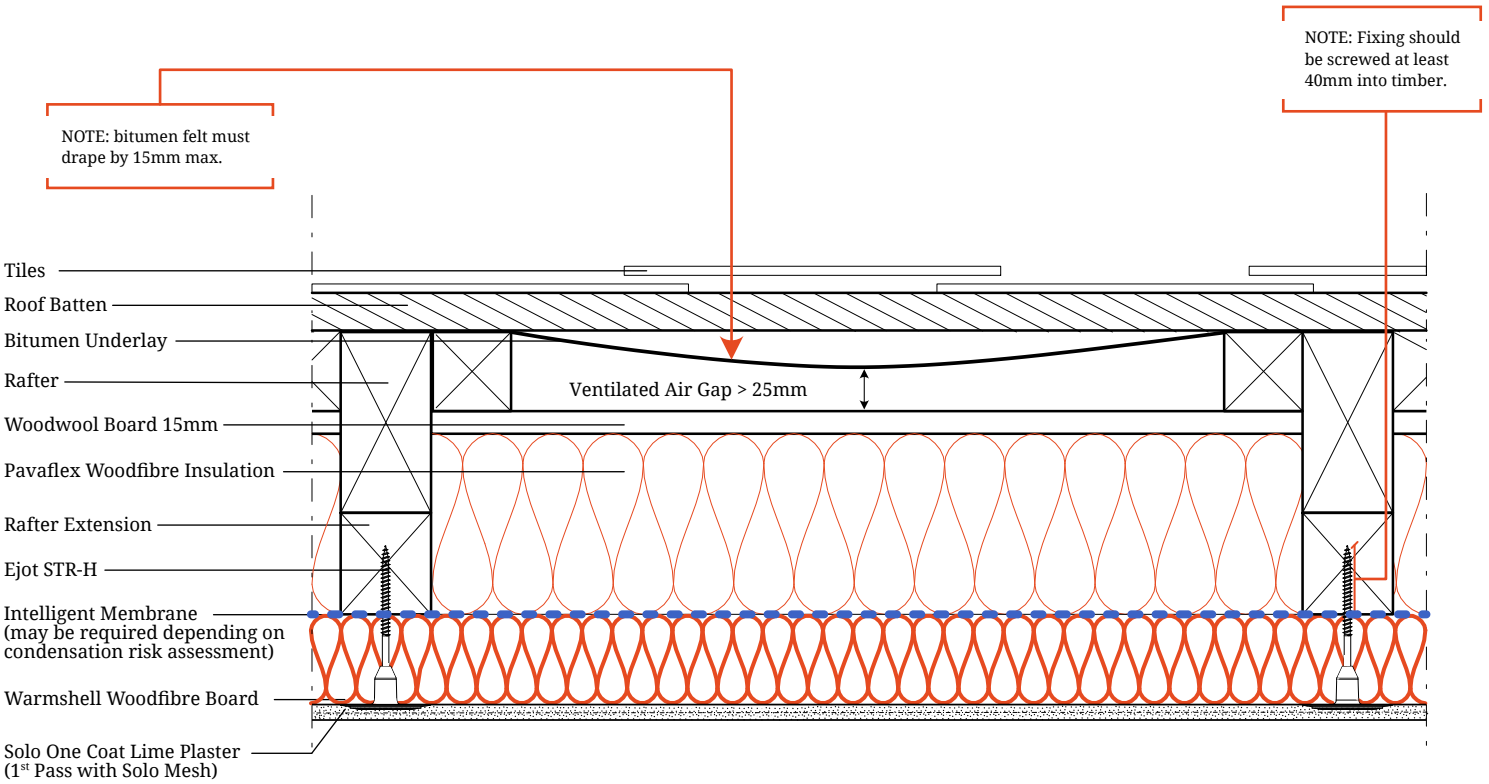
- Insulating between the rafters can be achieved from both sides
- Insulating between and on both sides can achieve very low
- U Values and good levels of airtightness

Architectural Details - With Notes

Drawing Title
Retrofit Pitched Roof with Existing Bitumen Underlay

Drawing No.
ROOF 001

For installing insulation from the inside, where the roof and a bitumen felt remain in situ.

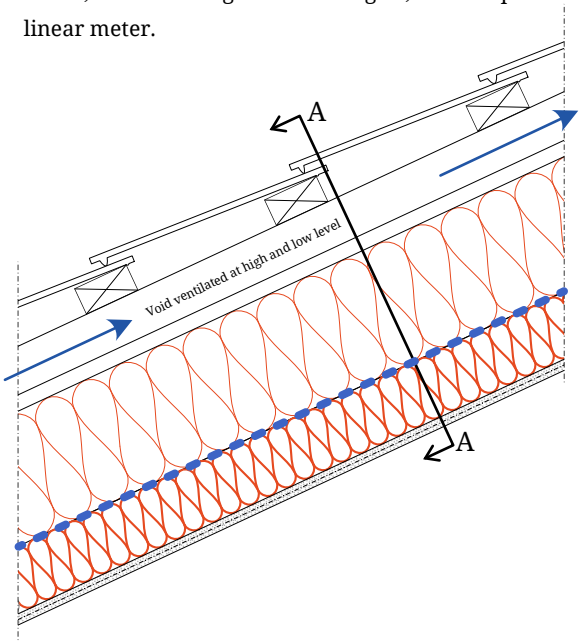


Retrofit Pitched Roof with Existing Bitumen Underlay

Section A-A / Not to Scale

Bitumen felt prevents the roof from breathing, therefore, a well-ventilated void must be formed between the insulation and the felt. Note that the depth of this void is given as a minimum of 25mm in BS5250, or 50mm in the Government Best Practice Guidance.

Ventilation must be formed at the top and bottom of each rafter void. Openings at the low level or eaves should have a minimum of 25,000mm² per linear meter, and at the high level or ridge 5,000mm² per linear meter.

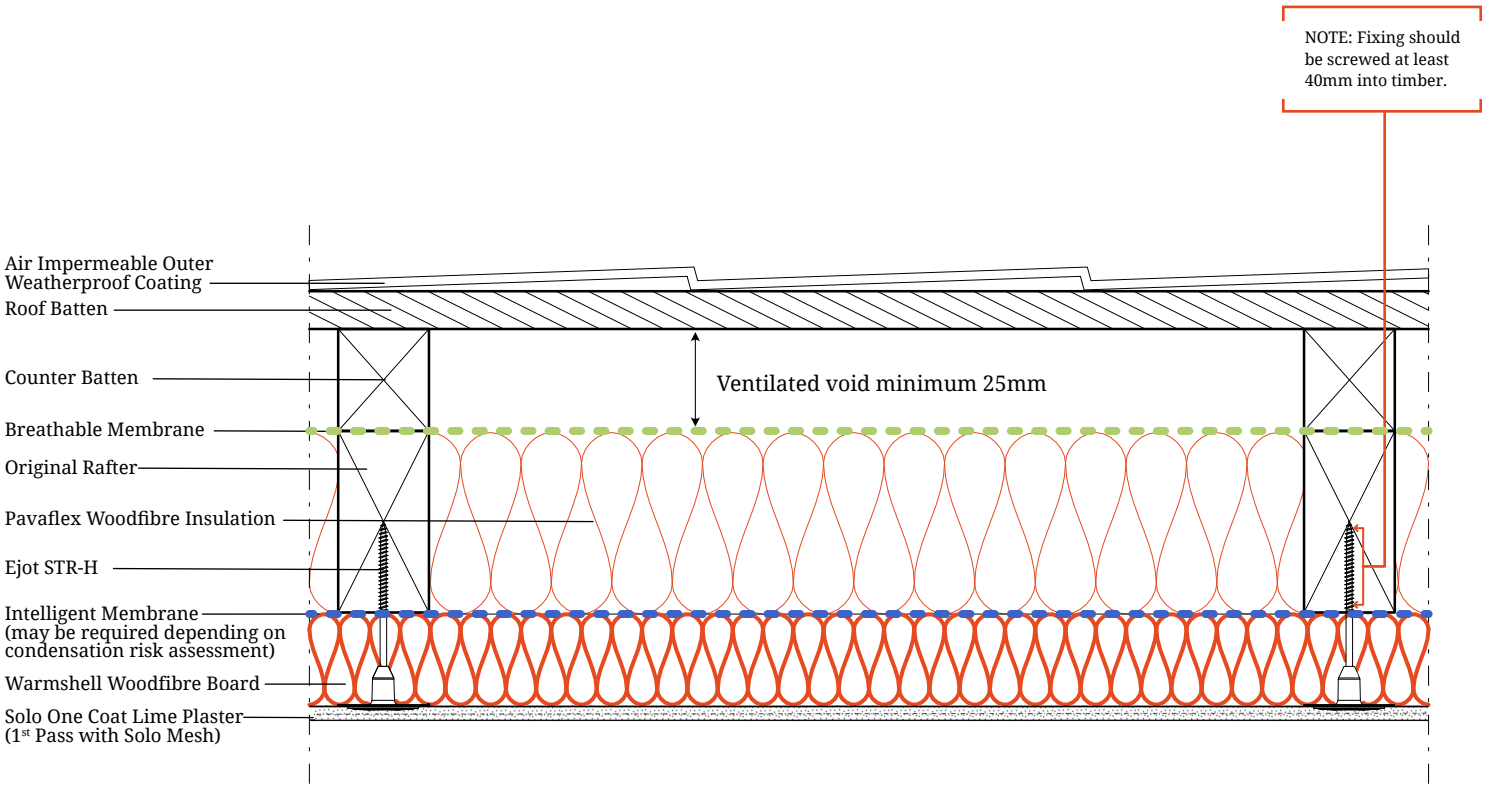


Architectural Details - With Notes

Drawing Title
Warm Roof with Low-Resistance Breathable Underlay

Drawing No.
ROOF 002

For installing insulation where a breather membrane is already installed.

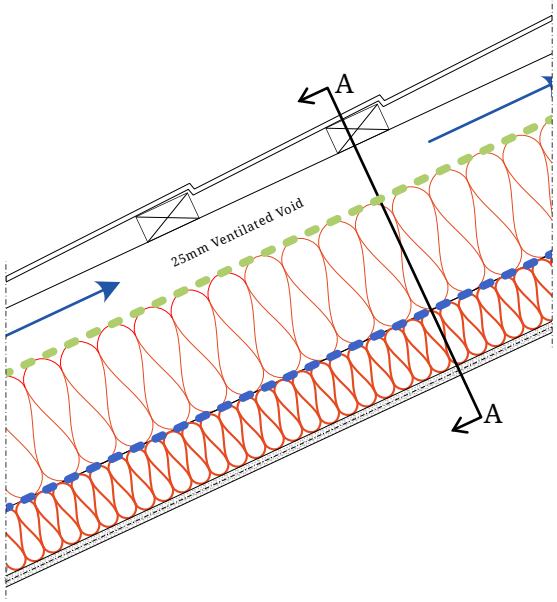


Warm Roof with Low-Resistance Breathable Underlay

Section A-A / Not to Scale

Solo One Coat Lime Plaster may not offer enough vapour resistance in this situation. A bespoke condensation risk analysis should be carried out.

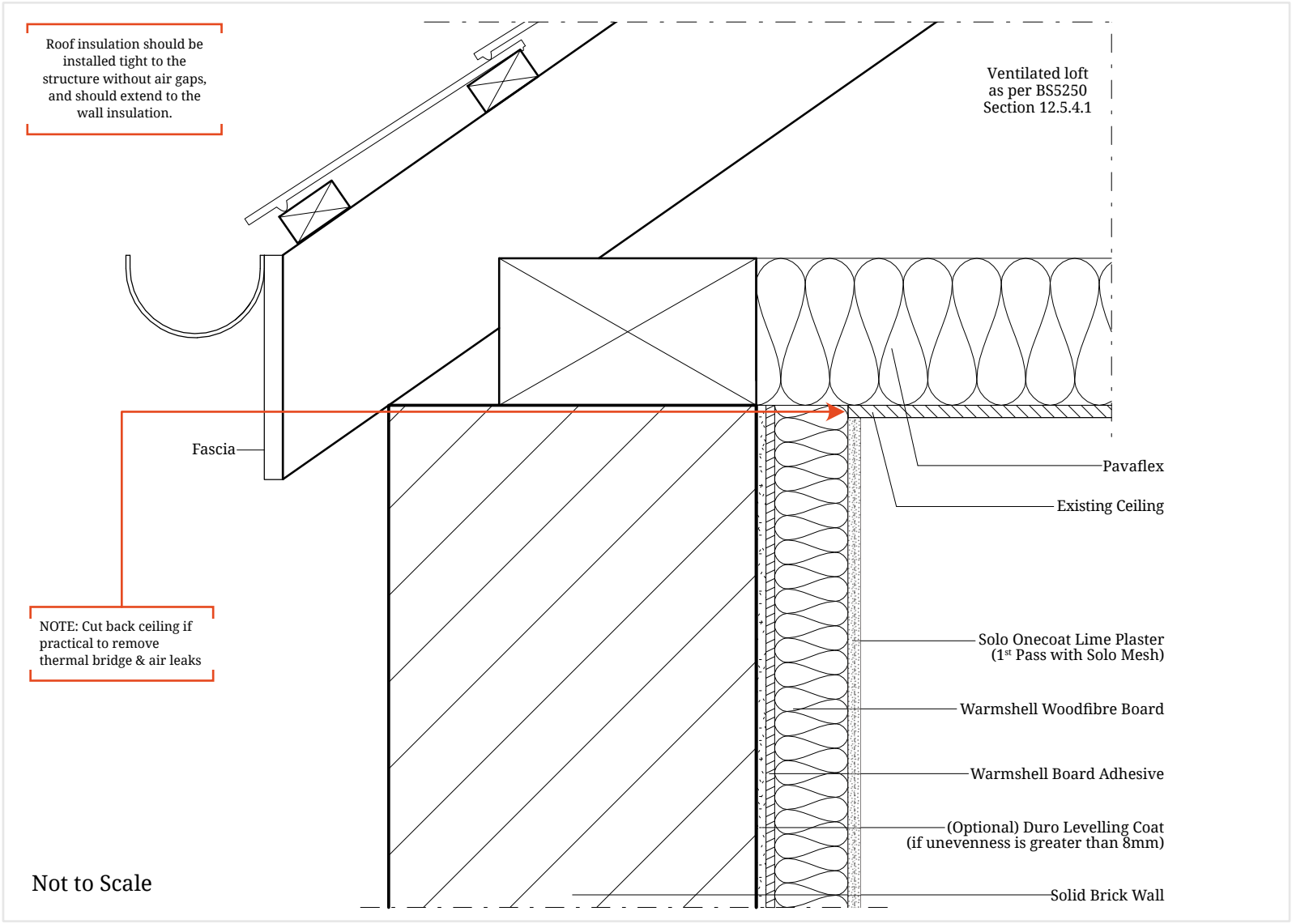
Ventilation must be formed at the top and bottom of each rafter void. Openings at the low level or eaves should have a minimum of 25,000mm² per linear meter, and at the high level or ridge 5,000mm² per linear meter.



Architectural Details - With Notes

Drawing Title
Cold Roof with Internal Wall Insulation

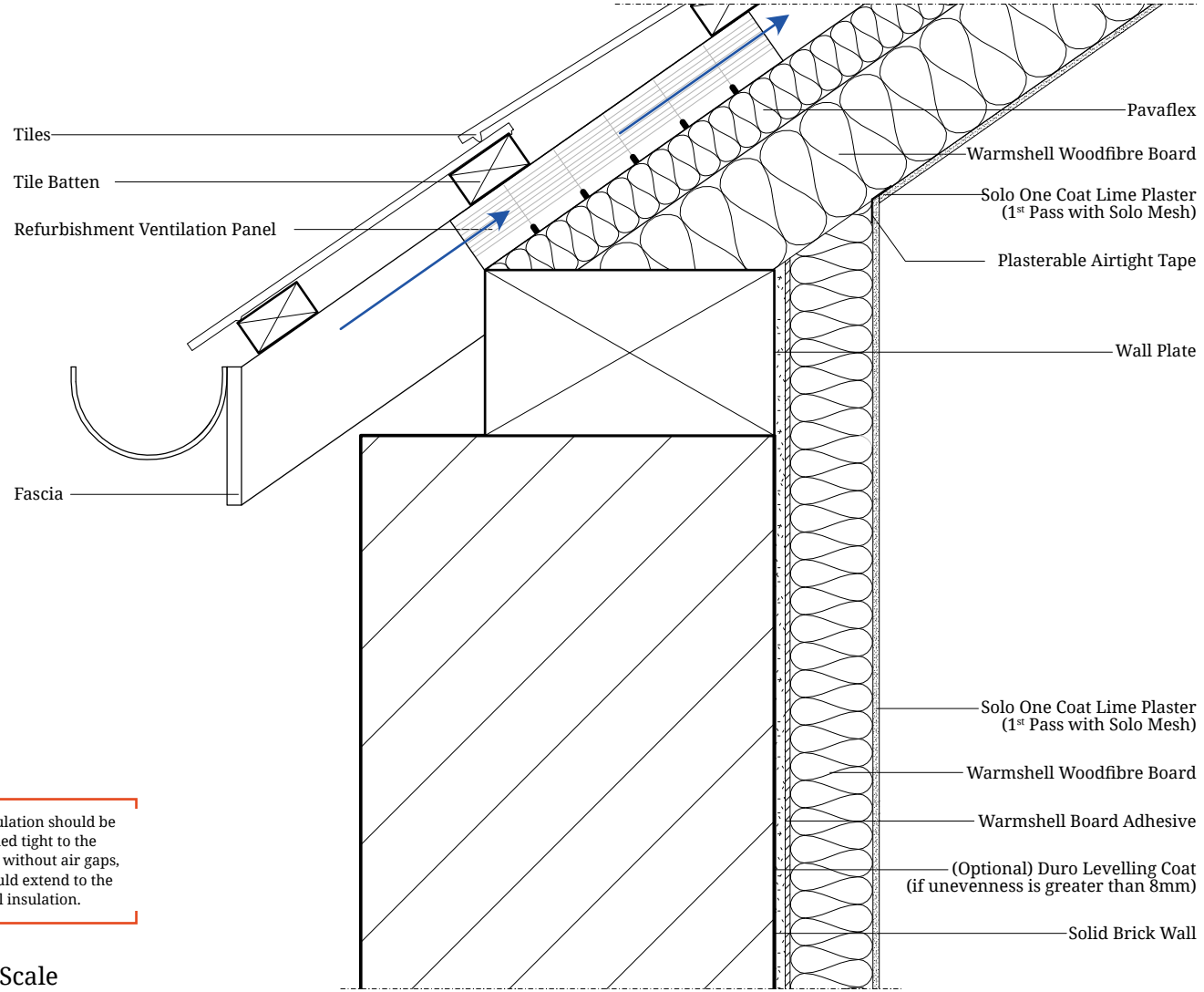
Drawing No.
ROOF 003



Architectural Details - With Notes

Drawing Title
Warm Roof with Internal Wall Insulation

Drawing No.
ROOF 004



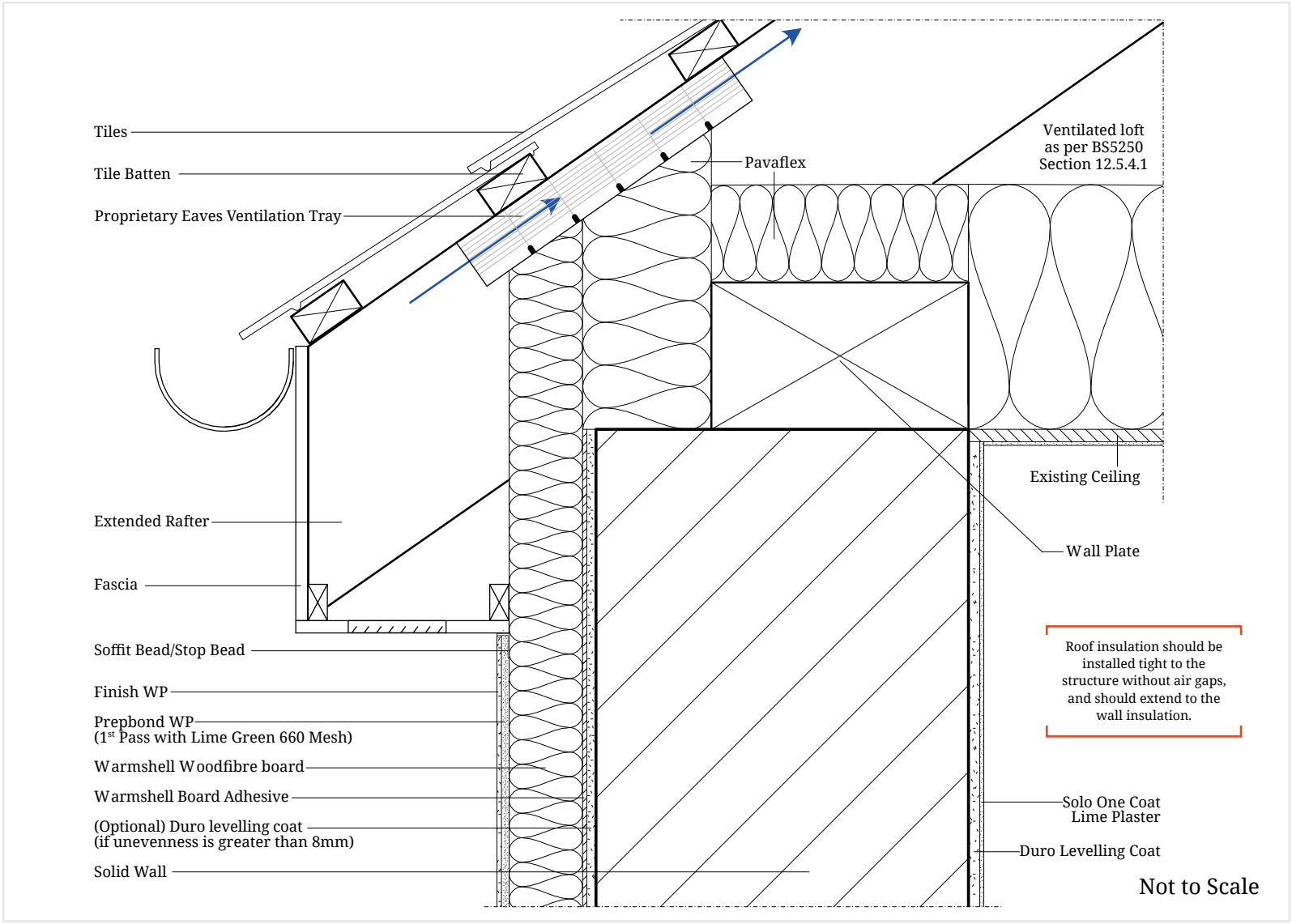
Roof insulation should be installed tight to the structure without air gaps, and should extend to the wall insulation.

Not to Scale

Architectural Details - With Notes

Drawing Title
Cold Roof with External Wall Insulation

Drawing No.
ROOF 005

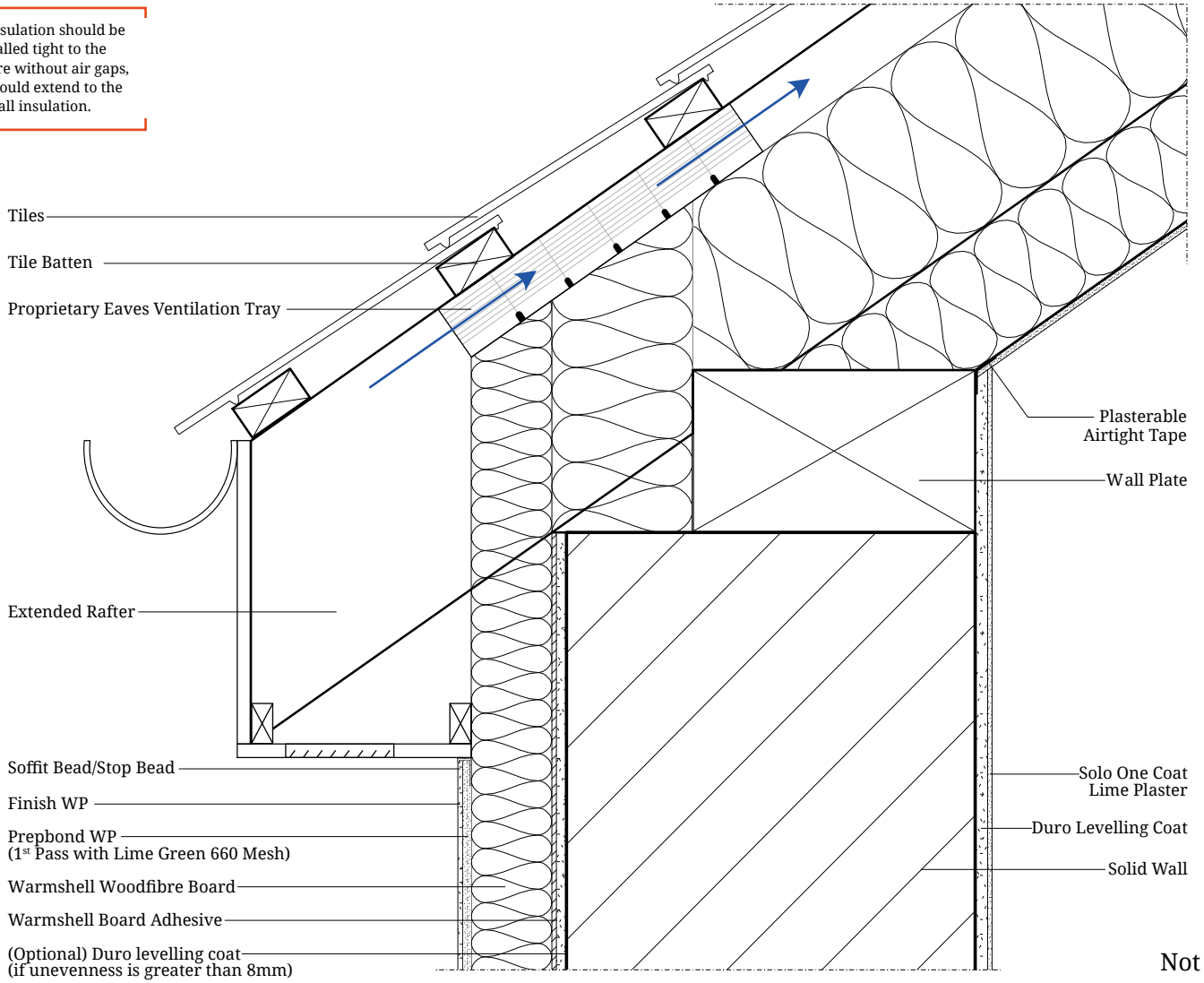


Architectural Details - With Notes

Drawing Title
Warm Roof with External Wall Insulation

Drawing No.
ROOF 006

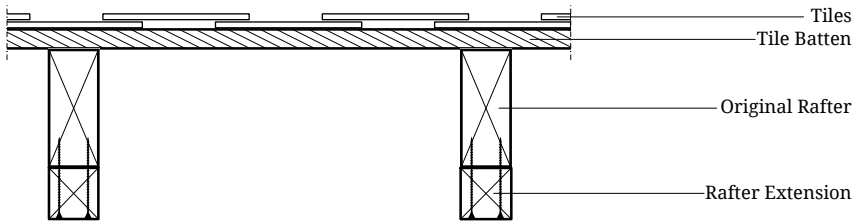
Roof insulation should be installed tight to the structure without air gaps, and should extend to the wall insulation.



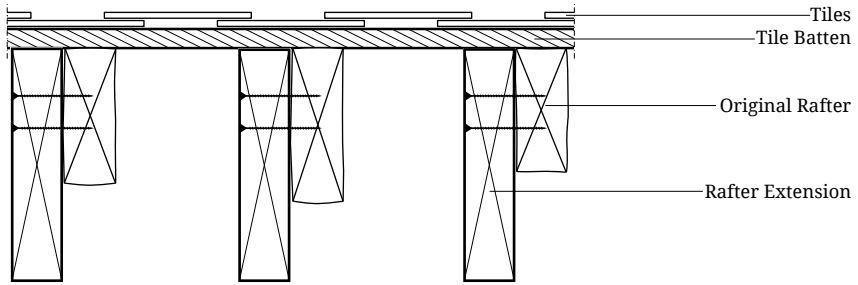
Insulating Roofs with Short, Uneven or Irregular Rafters

Sometimes, extending the existing rafters may be necessary to allow adequate ventilation above the insulation. This could be to increase the amount of insulation that can be installed to reach lower u-values than the existing rafter depth allows, or to provide a level surface for fixing Warmshell Woodfibre Boards to.

Rafter Extensions for Increased Ventilation or Insulation Thickness



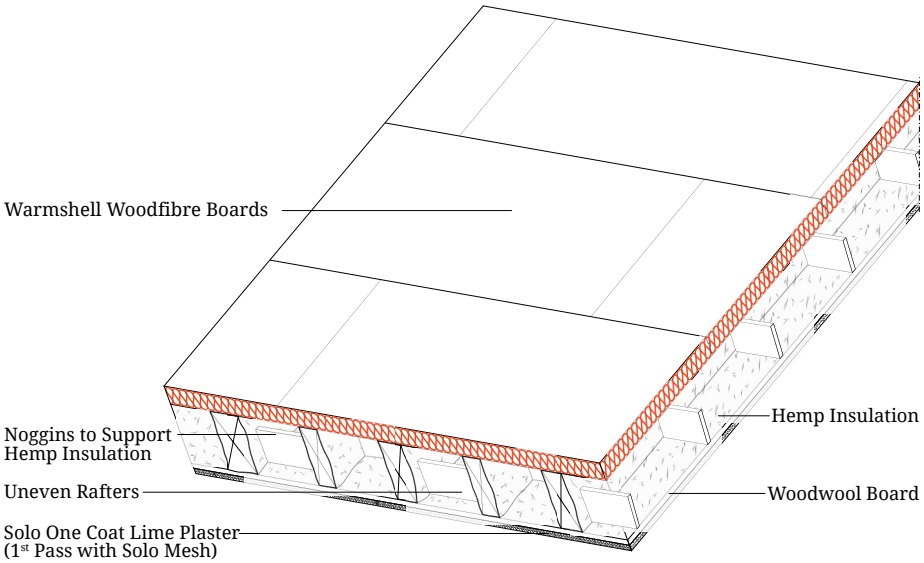
Rafter Extensions to create a level surface to install Warmshell Woodfibre Boards



Rafters that are extremely uneven and irregular, or have a very close spacing of the timbers can be incredibly difficult to insulate due to the large amount of cutting required. Casting hemp insulation can make this process easier with great results.

Torching only offers a very limited gain in U values, but the reduction in air leakage under tiles can make a noticeable improvement. Because there is so much air circulation from the inside, there is no need for vapour barriers or similar membranes.

Casting a hemp mix with *Lime Green Hemp Lime Binder* can be a far more practical option, and when installed in conjunction with a permanent shutter such as Warmshell Woodfibre Boards or Woodwool Boards underneath, thermal bridging and energy performance gaps can be reduced significantly.



U Values with Warmshell Woodfibre Insulation

Expected U Values: Woodfibre Insulation (e.g. 400mm centres)

Rafters infilled with Pavaflex (mm)	Warmshell Woodfibre Boards (mm)						
	40	60	80	100	120	140	160
50	0.46	0.38	0.31	0.27	0.24	0.21	0.20
80	0.36	0.31	0.26	0.23	0.21	0.19	0.17
100	0.31	0.37	0.24	0.21	0.19	0.18	0.16
*130**	0.26	0.24	0.21	0.19	0.17	0.16	0.15
140	0.25	0.22	0.20	0.18	0.17	0.15	0.14
*150**	0.24	0.21	0.19	0.17	0.16	0.15	0.14
*160**	0.23	0.21	0.18	0.17	0.16	0.15	0.14
*180**	0.21	0.19	0.17	0.16	0.15	0.14	0.13
*200**	0.19	0.18	0.16	0.15	0.14	0.13	0.12
*230**	0.18	0.16	0.15	0.14	0.13	0.12	0.12
*250**	0.17	0.15	0.14	0.13	0.13	0.12	0.11

Pavaflex batts are available in 50mm, 80mm, 100mm and 140mm.
*Insulation batts can be combined to give additional depths between rafters.

All calculations have been adjusted to allow for the difference in U Value when installing Warmshell Woodfibre with thermally broken fixings.

Expected U values: Woodfibre Insulation with Hemp (e.g. 200mm centres)

Rafters (mm) infilled with Hemp Insulation (0.068 W/mK)	Warmshell Woodfibre Boards (mm)						
	40	60	80	100	120	140	160
50	0.59	0.46	0.36	0.31	0.27	0.24	0.21
75	0.50	0.41	0.32	0.28	0.25	0.22	0.20
80	0.48	0.40	0.32	0.27	0.24	0.22	0.20
100	0.43	0.36	0.29	0.26	0.23	0.21	0.19
150	0.34	0.30	0.25	0.22	0.20	0.18	0.17
200	0.28	0.25	0.22	0.20	0.18	0.16	0.15
250	0.24	0.22	0.19	0.18	0.16	0.15	0.14

U Values that fall between improved and threshold values as stated in Table 4.3 of ADL1B (2021) for existing dwellings.

U Values that meet Passivhaus standards.

U Value as stated in Table 1.1 of ADL1B (2021) for new dwellings.

U Value as stated in Table 4.2 of ADL1B (2021) for new fabric elements in existing dwellings.

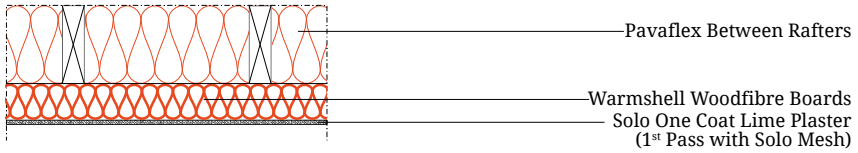
Bespoke U Value calculations can be calculated upon request.

Finishing Options with Solo® One Coat Lime Plaster

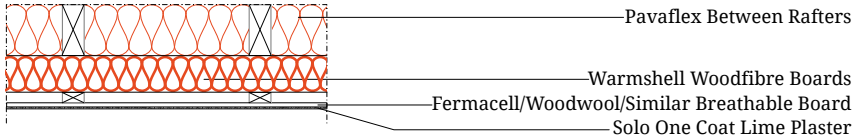
Solo® One Coat Lime Plaster is a breathable, lime based plaster made from recycled content. Offering all the qualities of a traditional Lime Plaster without the limitations, Solo regulates humidity effectively and allows the building to breathe, creating a healthy indoor environment. Working with lime used to be painstakingly hard work. Now, everyone can create works of beauty, without losing the benefits, qualities and advantages of lime.

Finishing Options

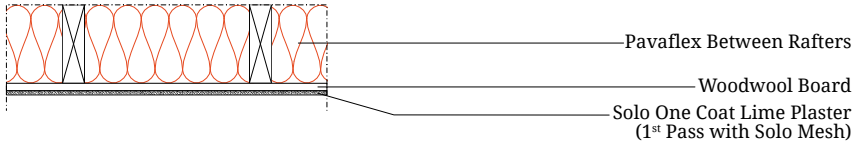
Plastering directly over Warmshell Woodfibre Boards



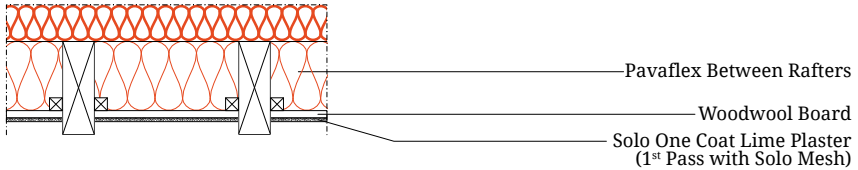
Installing a service void



Plastering directly under rafters



Where rafters/purlins are to remain exposed



Your builder or plasterer can alter the finish by using various tools and techniques. Whether you prefer a sophisticated and clean finish or a more rustic and textured one, Solo One Coat Lime Plaster offers the versatility to give you the unique finish you desire.

Breathable paints and lime washes can be applied over Solo One Coat Lime Plaster, or the plaster can be left unpainted for a natural finish.

Finishes

lime|green

Opening: **Mon - Fri 8:30am - 5:00pm**

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