



Underwood, Parkmill EnerPHit Assessment

Property Reference: 5026

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1. Executive Summary

This report presents a deep retrofit proposal for Underwood, an original period cottage in the Gower Area of Outstanding Beauty. The property currently operates with poor thermal performance, with the space-heating demand modelled at $394.2 \text{ kWh/m}^2\cdot\text{a}$ and a recorded LPG heating usage of $430.66 \text{ kWh/m}^2\cdot\text{a}$. Both figures verify the existing dwelling has a very high operational heating demand.

The proposed retrofit strategy has been developed using the Passive House Planning Package (PHPP) to test the impact of fabric and mechanical interventions. The baseline PHPP model shows a heating demand of $394.1 \text{ kWh/m}^2\cdot\text{a}$ while the proposed retrofit model reduces this to $66.2 \text{ kWh/m}^2\cdot\text{a}$. This represents a reduction of approximately 83% from the PHPP baseline.

The proposed interventions include vapour-open external wall insulation, roof and floor insulation, high-performance windows and doors, airtightness works, thermal bridge reduction, mechanical ventilation with heat recovery and the installation of an air source heat pump. The specification prioritises breathability and moisture management to protect the limestone construction, whilst also improving occupant comfort and health. Although the proposal does not meet the full EnerPHit heating-demand target, it provides a robust EnerPHit-informed deep retrofit pathway suited to the constraints of the existing building.



(On The Market 2025)

2. Introduction

The Underwood Cottage is in Parkmill, Gower SA3 2EH. The property is described as a period cottage in the heart of the Gower Area of Outstanding Beauty (Swansea Council N.D.a) comprising three bedrooms, two reception rooms, a kitchen/breakfast room, utility, WC and family bathroom (The Greenroom Estate Agents 2025).

The building has a mixture of original limestone construction and later masonry alterations (Swansea Council, n.d.b; Swansea Council, n.d.c; Swansea Council, n.d.d). This structural variety presents a specific challenge because each construction has different thermal, moisture and junction characteristics.

The property is currently on mains electricity and water, with central heating fired by LPG and underfloor heating installed to the ground floor. The client has provided the specification for the existing LPG boiler confirming a Worcester Bosch Greenstar 30I. While the boiler is relatively modern the fuel-use data shows that the primary issue is not simple plant efficiency but the underlying heating demand of the property.

This report evaluates the feasibility of retrofitting Underwood towards the Enerphit standard, the Passivhaus retrofit standard for existing buildings. Enerphit is intended for older buildings that cannot reasonably achieve the full Passivhaus retrofit standard because of existing constraints. Additionally, PHPP is intended to be used during design rather than a late-stage compliance check (Taylor 2011; Traynor 2019; Lewis 2026).

3. Basis of Assessment and Key Assumptions

This assessment has been undertaken using site plans, drawings, estate information, LPG and electricity records, boiler documentation, airtightness test results, WUFI moisture assessments and PHPP U-Value outputs [Lewis 2026].

The following assumptions have been made to the PHPP model:

Item	Assumption
Occupancy	Family of four to establish ventilation requirements, domestic hot water demand and internal gains
Climate	Swansea regional climate data
Floor area	TFA: 83m ² Floor Area: 90m ²
Existing Heating	LPG boiler with underfloor heating to ground floor and radiators upstairs
Existing ventilation	Natural ventilation with background leakage and local extraction to wet areas

Existing Thermal Bridges	Conservative assumptions made until further investigative works
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Before technical design, the following should be verified on site:

- Intrusive investigation into the wall make-up and junction details
- Presence & condition of DPC and cavities to modern extensions
- Window installation method
- Planning limitations associated with the Gower Area of Outstanding Beauty
- Whether the planning approved extension is to be completed as part of the retrofit scheme (Swansea Council, n.d.b; Swansea Council, n.d.c; Swansea Council, n.d.d).

4. Existing Building Description

Underwood is a compact two-storey period cottage. The floorplan confirms a kitchen, dining room, living room, utility, WC, 3 bedrooms and landing. The site plan identifies the building in a shaded setting with road frontage, garden areas and a large rock bank at the rear elevation. These conditions are important as deep retrofit detailing is affected by access, wall exposure and the ability to continue EWI below finished external levels.

The Swansea planning portal also notes that the property benefits from planning permission for a two-storey extension, first floor extension and outbuilding (Swansea Council, n.d.b; Swansea Council, n.d.c; Swansea Council, n.d.d). If these works are progressed, they should be integrated into the retrofit strategy rather than designed separately. Any new extension should conform to Enerphit standards from the outset to avoid creating potential fabric issues.

5. Existing Fabric and M&E Provisions

The existing fabric consists of multiple external wall construction types as well as both cold and warm ceiling sections to the first floor. This has resulted in an inconsistent thermal performance throughout the property (BSI 2021).

5.1 External Walls

The primary dwelling is understood to be of traditional limestone construction, with later masonry extensions. The existing PHPP model identifies the main solid wall construction as thermally poor, with a baseline U-value of 2.211 W/M²K. This is consistent with uninsulated solid masonry construction and represents one of the main heat-loss elements.

Additionally, the rear section of this solid stone wall is built directly against a rock bank at the rear of the property, this currently poses a significant risk for moisture bridging into the structure (Under One Roof, n.d.; SPAB, n.d.).

Traditional solid masonry also presents moisture risks. Unlike modern cavity construction, historic stone relies on vapour movement to prevent moisture being trapped within the structure. Any retrofit strategy must consider breathability of materials to prevent this (SPAB, n.d.; BSI, 2021).

The cavity extensions have been modelled in PHPP and fall short of the Enerphit-level of performance, despite being significantly better than the original stonework. The uninsulated full height extension is a 1970s uninsulated blockwork cavity wall modelled at 0.524 W/M²K, while the later half height 2005 extension is constructed of insulated block cavity wall modelled at 0.444 W/M²K.

5.2 Roof and Ceilings

The building currently has a pitched cut roof with Welsh slate roof coverings and contains a mixture of vaulted ceiling sections and conventional ceilings. The existing vaulted ceiling present in the bathroom is modelled at a U-value of 0.430 W/M²K whilst the conventional ceiling is modelled at 0.158 W/M²K.

Further improvements should be undertaken where headroom, roof condition and buildability allow. Roof retrofit works must also maintain appropriate ventilation, weathering and moisture control, particularly where insulation is added between or below rafters (BSI, 2021; BRE, 2005).

5.3 Ground Floor

The ground floor is a key concern. The existing floor build-up is an uninsulated ground bearing slab with underfloor heating. The PHPP model indicated a very poor thermal performance, modelled at 3.068 W/M²K.

The presence of underfloor heating is positive for future low-temperature heating, but if the slab is poorly insulated, heat loss to ground will remain significant. Ground-floor insulation must also be designed with moisture control in mind, as damp-proof membranes should prevent the transfer of liquid water and water vapour from the ground and should be continuous with DPCs where relevant (Stirling, 2001).

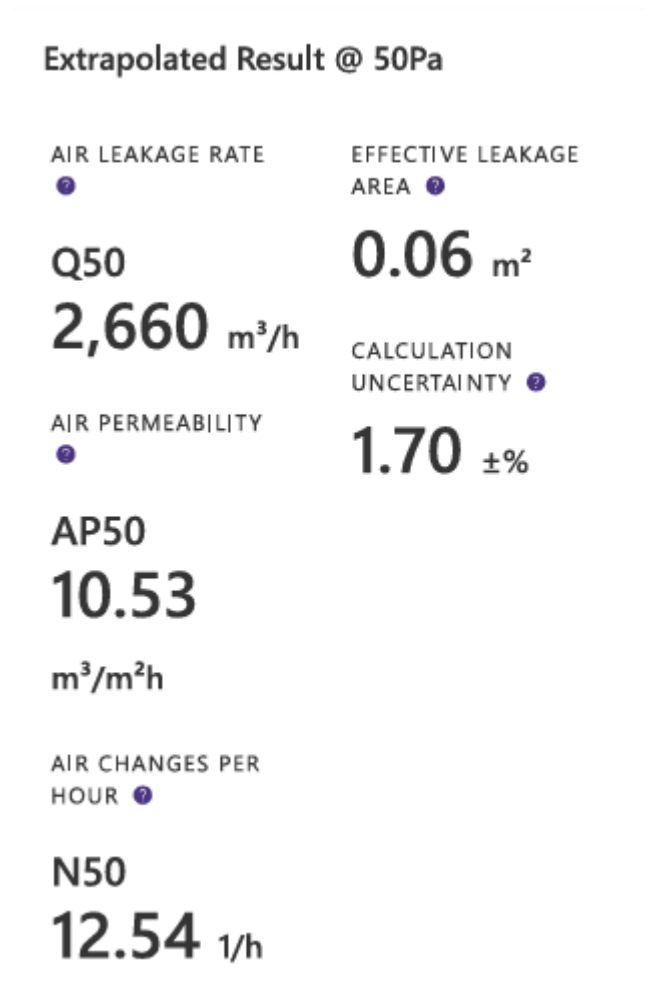
5.4 Windows & Doors

The windows throughout the property are PVC frames from 1995. Rooflights are present in the vaulted ceiling section in the bathroom. The mains doors in the property are softwood doors with no glazing; a set of PVC French doors from 2005 are present to the rear half height extension. All glazing used in the property is double-glazed.

The existing windows and doors are likely to contribute to heat loss and air infiltration and will not meet the performance standard of EnerPHit (Taylor, 2011; Traynor, 2019).

5.5 Airtightness

An airtightness test has been conducted on the property with the following results:



The airtightness recorded is 12.54 h⁻¹ @ 50 Pa which is significantly above the EnerPHit airtightness requirement of <1.0 h⁻¹ @ 50 Pa (Taylor, 2011; Traynor, 2019).

Uncontrolled air leakage increases heating demand, creates cold draughts and can contribute to moisture damage where warm moist air passes through the building fabric and condenses within construction layers (BRE, n.d.; Bleicher, 2025).

5.6 Heating and Hot Water

The property is currently heated by LPG via a Worcester Bosch Greenstar 30i LPG boiler installed in 2024. The underfloor heating system is beneficial because it can operate at lower flow temperatures than conventional radiators, supporting the transition to a heat pump (Welsh Government, 2024).

5.7 Existing Energy Use

The LPG records from December 2023 to March 2025 show a total LPG use of 6,469 litres, equivalent to 4,851 litres per year. Converting this into kWh provides an annual usage of 34,350 kWh/year or 430.66 kWh/m²·a. This equates to roughly £237.17 a month to heat the property at a TFA of 83m².

6. PHPP Baseline and Retrofit Model Results

The PHPP baseline and retrofit model outputs are summarised below:

PHPP Model	TFA	Heating Demand kWh/m ²
Existing Baseline	83m ²	394.1
Proposed Retrofit	83m ²	66.2

The proposed retrofit interventions will reduce heating demand by approximately:

$$327.9/394.1 \times 100 = 83.2\%$$

This is a substantial reduction and demonstrates the value of a coordinated deep retrofit strategy. Despite this, the proposed retrofit model remains above the typical EnerPHit heating demand of <25 kWh/m²·a. EnerPHit guidance recognises that existing buildings may be constrained to fixed form, historic fabric, orientation, existing architecture and conservation/planning requirements (Taylor, 2011; Traynor, 2019).

The current proposal should therefore be described as an EnerPHit-informed deep retrofit.

7. Proposed Retrofit Interventions

7.1 External Wall Insulation

The principal fabric intervention is external wall insulation to both the solid and cavity walls. External wall insulation is preferred over internal wall insulation because it provides a more continuous thermal envelope, reduces thermal bridging and preserves internal floor area (Traynor, 2019; INCA, 2015).

The PHPP retrofit model improves the U-values of the walls to the following figures:

Wall Construction	Baseline U-Value W/M ² K	Retrofit U-Value W/M ² K
Solid Limestone	2.21	0.258
1970s Cavity	0.524	0.187
2005 Insulated Cavity	0.444	0.176

The PHPP model improves the U-values significantly, however it still falls short of the EnerPHit component criteria of $<0.150 \text{ W/M}^2\text{K}$. Further PHPP testing should therefore be considered to increase insulation thickness or selective improved detailing where buildability allows (Taylor, 2011).

The following wall makeup should be utilised for Underwood:

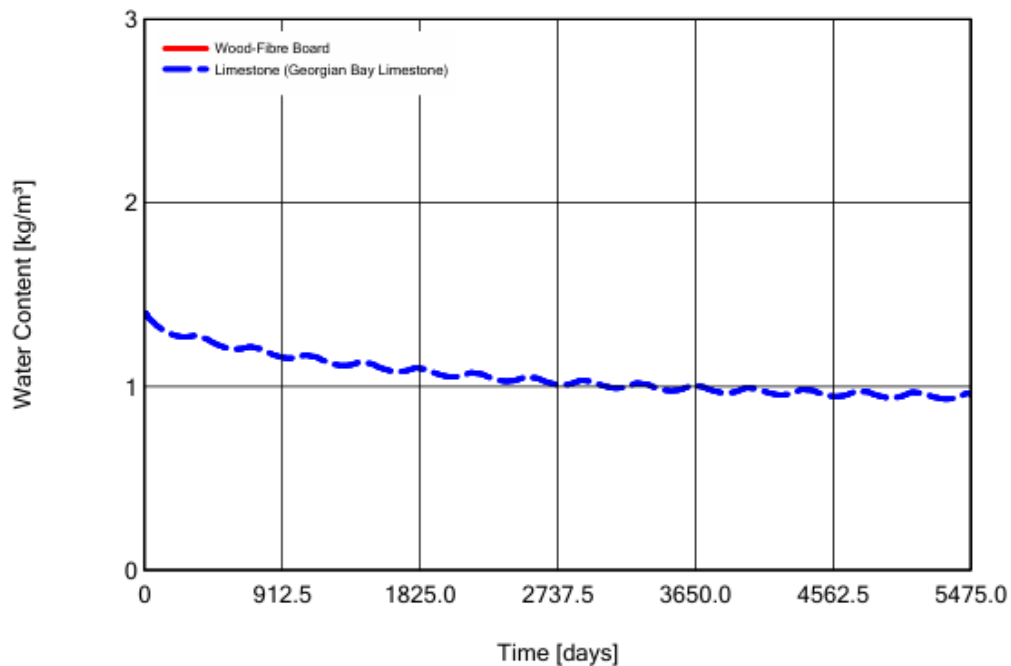
Layer	Approach
Airtight Layer	Lime compatible parge coat
Existing Substrate	Retain Limestone/Masonry walls and remove impermeable defective coatings where required
Insulation	120mm Rockwool Frontrock with system designed fixings
Basecoat	Vapour-Open reinforced basecoat
Finish	Lime render compatible with heritage appearance

A further enabling intervention is required to address the rear rock face, which currently abuts or closely bridges the rear of the property. This condition creates a significant thermal bridge and moisture risk, as the rock face can maintain a cold, damp connection to the external wall, limiting the effectiveness of the proposed insulation strategy and increasing the risk of localised condensation, damp staining and mould growth internally. To achieve a continuous thermal envelope, the rear rock face should be carefully excavated or cut back to provide sufficient clearance for external insulation and long-term inspection access (mwclubb, 2024; Under One Roof, n.d).

Due to the proximity of the rock face to the existing structure, this work must be developed with input from a structural engineer. The engineer should assess the stability of the rock and retaining conditions, then specify any required temporary works during excavation and the permanent retaining, drainage or stabilisation measures needed once the works are complete. This item should be treated as a critical enabling work package, as failure to resolve the rear bridging condition would compromise the performance of the wall insulation, airtightness strategy and moisture-safe retrofit design (INCA, 2015; BSI, 2021).

7.2 Moisture-Safe Wall Strategy

The wall insulation must be selected for hygrothermal safety. WUFI outputs show that the use of Woodfibre or mineral wool insulation reduces moisture content within the construction whilst retaining the vapour-open build up (BSI, 2023).



For this building mineral wool is preferred over EPS as a vapour open system better aligns to the moisture behaviour of a solid wall and reduces the risk of trapped moisture, despite the greater thermal performance of EPS (BSI, 2021; SPAB, n.d.).

7.3 Roof and Ceiling Insulation

Roof improvements should be coordinated with airtightness and ventilation works. The PHPP models improve ceiling thermal performance as highlighted below:

Ceiling Type	Baseline U-Value W/M²K	Retrofit U-Value W/M²K
Vaulted Ceiling	0.430	0.247
Conventional Ceiling	0.158	0.145

The proposed specification for this is:

Roof/Ceiling Area	Intervention
Vaulted Ceiling	Add insulation between rafters and insulated plasterboard below rafters
Conventional Ceiling	Top up mineral wool insulation to 300mm and ensure homogeneous spread
Eaves	Maintain ventilation to loft space, avoid blocking airflow from eaves
Airtightness	Ensure continuous plaster connected to wall airtight layers

Thermal bridges	Treat eaves, gables, chimney penetrations and rooflight reveals
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When insulating the vaulted ceiling section, a 50mm gap should remain between the insulation layer and roofing felt to promote crossflow ventilation (BSI, 2021).

To accommodate the increased wall thickness created by the EWI system, the existing roof overhang will need to be extended at the eaves and verges. The associated works are likely to include extending rafter feet, adjusting fascias and soffits, relocating rainwater goods and increasing verge protection. Where the lower section of the roof is altered the slate gauge may need to be adjusted to maintain correct laps (BRE, 2005). These works should be coordinated with the airtightness line and roof insulation upgrades so that the roof, wall insulation and rainwater management strategy form one continuous weather-tight detail (Traynor, 2019; BSI, 2021).

7.4 Ground Floor Insulation

The retrofit model improves the solid ground bearing slab to 0.229 W/M²K using Celotex GA4000 insulation. Floor works will be disruptive; however the existing floor slab has the lowest thermal performance of any element necessitating intervention.

The proposed makeup of the floor slab is:

Floor layer	Existing Makeup	Proposed Makeup
Finished Floor	20mm Stone Tiling	20mm Stone Tiling
Screed	80mm Screed	50mm Screed
DPM	Not Present	1200 Gauge Polythene DPM lapped to external/internal walls
Insulation	Not present	90mm Celotex GA4000 PIR
Floor Slab	125mm Slab	90mm Concrete slab with steel mesh

Ground floor insulation must be designed with moisture protection; damp-proof membranes should prevent transfer of liquid water and vapour from the ground and should be continuous with DPCs where relevant (Stirling, 2001). The DPM should be tied into the DPCs present in the modern cavity walls and taped to the solid stone wall airtightness layer to reduce moisture rise by capillary action. If hydrostatic pressure or significant groundwater risk is identified, a separate waterproofing strategy should be developed. (British Board of Agrément, 2019).

7.5 Windows and Doors

The proposed retrofit should replace existing windows and external doors to high-performance Passivhaus accredited units with triple glazing and insulated frames. To meet EnerPHit standards window performance must be $<0.85 \text{ W/M}^2\text{K}$ and external doors $<0.80 \text{ W/M}^2\text{K}$ (Taylor, 2011).

Installation position is crucial as windows should be aligned within the insulation zones where possible, using structural brackets, insulated reveals and airtight tapes to reduce cold bridging (INCA, 2015; Insulated Render and Cladding Association, 2017).

The following frames and glazing should be used for Underwood:

Element	Window Frame	Glazing
Windows	Rehau Geneo 0978wi03	Eagon Super VIG plus 1190gl03
Rooflight	Velux GGU 0592rw02	Eagon Super VIG plus 1190gl03
Kitchen Door & French Door	Enersign Primus 1194ws02	Rehau Geneo PHZ 0180ed03 & Eagon Super VIG plus 1190gl03
Front Door	Rehau Agila 11113cd03	Rehau Geneo PHZ 0180ed03

All frames have been chosen based on Passivhaus accreditation and UK availability (Passive House Institute, 2021; Passive House Institute, 2014; ENERsign GmbH, 2022).

7.6 Airtightness Strategy

The existing airtightness result of 12.54 h^{-1} @ 50 Pa is far from the EnerPHit standard of $<1.0 \text{ h}^{-1}$ @ 50 Pa (Taylor, 2011; Traynor, 2019). The proposed airtightness strategy should include:

Area	Airtightness Strategy
External Walls	Airtight lime render layer
Ceiling-wall junction	Taped membrane or wet plaster connection
Floor-Wall Junction	Sealed junction between slab/DLM and wall airtight layer
Windows & doors	Airtight tape internally & windtight externally
Chimneys	Decommission, cap and seal unused flues or use room-sealed appliances only
Services	Group penetrations and seal with proprietary grommets

Intermediate floors

Treat joist ends and perimeter leakage routes

Airtightness should be tested in stages: first as a diagnostic pre-test, which has already been undertaken, then once the airtight layer is complete and finally at completion.

Airtightness tests should utilise smoke, thermography and other methods to identify leakage paths to be addressed (BRE, n.d.; Bleicher, 2025).

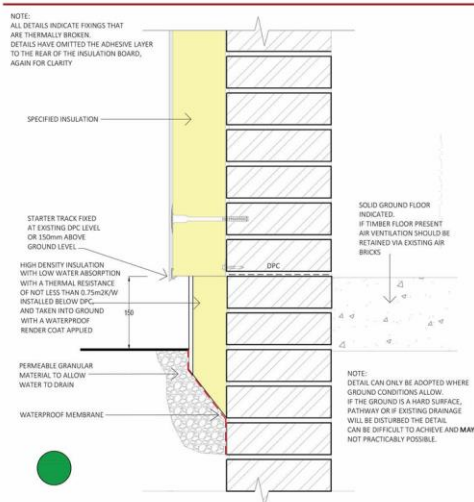
7.7 Thermal Bridging

Thermal bridging is a major risk in solid wall retrofit, particularly at plinths, window reveals, floor edges and roof junctions. Supplied Therm results show the following the Psi-Value with a plinth to be 0.011 W/mK whereas the absence of a plinth shows 0.056 W/mK.

The value of 0.011 W/mK is close to, but slightly above, the demanding EnerPHit thermal bridge threshold of approximately ≤ 0.01 W/mK. While not all Underwood details are likely to achieve this, the modelling clearly shows that continuous insulation should be prioritised. (Taylor, 2011; BSI, 2017a).

To provide this continuous detail below the external ground level, XPS will have to be used as mineral wool does not have the necessary moisture resistance to be below ground (Celotex, n.d.c). The below details should be adhered to for EWI installation to prevent thermal bridging:

THERMAL BRIDGING DETAILS

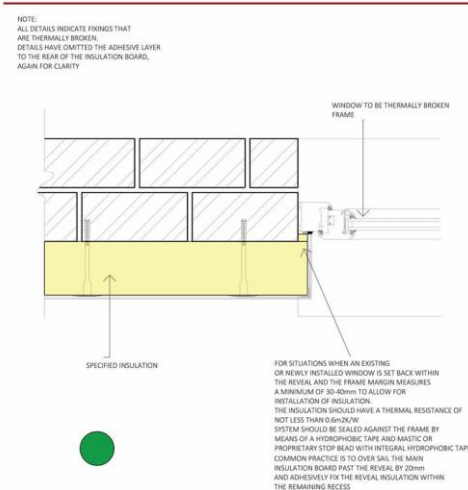


Title:	Insulated Plinth Detail
Dwg. No.	TBD-003
Rev.	B

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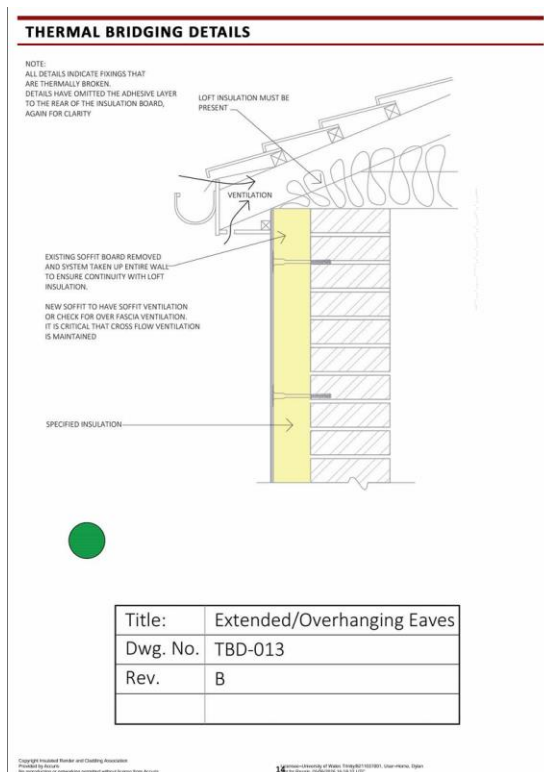
THERMAL BRIDGING DETAILS



Title:	Insulation to recessed reveal
Dwg. No.	TBD-004
Rev.	B

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(Insulated Render and Cladding Association, 2017)

7.8 Mechanical Ventilation with Heat Recovery

Once airtightness is improved, controlled ventilation becomes essential for occupant health. The proposed system is a Zehnder ComfoAir Q450, a whole-house MVHR unit serving bedrooms and living areas with supply air, and extracting from kitchen, WC, bathroom and utility. The MVHR system should be designed with low sound emissions and lack of perceptible draughts (Passivhaus Trust, 2018).

The MVHR system will meet the necessary supply rate of $30 \text{ m}^3/\text{h}$ per occupant, equating to $120 \text{ m}^3/\text{h}$ for four occupants. The Zehnder ComfoAir Q450 also exceeds the electrical efficiency required for EnerPHit standard of $<0.45 \text{ Wh}/\text{m}^3$ with $0.21 \text{ Wh}/\text{m}^3$ and with a modelled heat recovery efficiency of 76.3% meets the EnerPHit standard of $>75\%$ (Taylor, 2011; Passive House Institute, 2026).

The MVHR is central to the comfort and health strategy. It reduces moisture accumulation, controls indoor pollutants and allows for airtightness improvements. Additionally, the redundant chimney breast can be utilised for ducting runs to the first floor.

7.9 Heating and Hot Water

The existing LPG boiler is relatively recent, so immediate replacement is not essential if the budget is prioritised towards fabric-first works. However, the long-term strategy should be to transition away from LPG once heat demand has been reduced.

Following the fabric improvements, a Aquarea J series WH-UD05JE5 Air Source Heat Pump has been modelled within the PHPP retrofit scenario to assess the impact of replacing the LPG system. The existing underfloor heating is advantageous as it is better suited to the low-temperature distribution than conventional high-temperature radiator systems. However, before a heat pump is installed, the final heat loss should be recalculated in PHPP, and the existing heat emitters should be checked to confirm that they can meet room-by-room heat loads at suitable flow temperatures. Domestic hot water provision should also be reviewed, including cylinder sizing, insulation, pipework losses and controls (Panasonic, 2019; Welsh Government, 2024).

8. Retrofit Performance Summary

Measure	Existing Condition	Proposed Condition
Main Walls	Stone: 2.211 W/m ² K 1970s Cavity: 0.524 W/m ² K 2005 Cavity: 0.444 W/m ² K	Stone: 0.258 W/m ² K 1970s Cavity: 0.187 W/m ² K 2005 Cavity: 0.176 W/m ² K
Vaulted Ceiling	0.430 W/m ² K	0.247 W/m ² K
Conventional Ceiling	0.158 W/m ² K	0.145 W/m ² K
Solid Floor	3.068 W/m ² K	0.229 W/m ² K
Airtightness	12.54h ⁻¹ @50Pa	<1.0h ⁻¹ @50Pa
Windows	Existing PVC Double Glazed Units	High-Performance triple glazed units with Passivhaus accreditation
Ventilation	Localised extract to wet rooms & air leakage	Zehnder ComfoAir Q450 MVHR system
Heating	Worcester Bosch Greenstar 30i LPG Boiler	Aquarea J series WH-UD05JE5 Air Source Heat Pump

9. Comfort, Health and Indoor Environmental Quality

The retrofit package is expected to significantly improve occupant comfort. The main comfort benefits are:

Existing Issues	Retrofit Response
Cold Wall Surfaces	EWI raises internal surface temperatures
Draughts	Airtightness works reduce uncontrolled leakage
Cold Floors	Floor insulation improves surface temperature

Condensation Risk/Humidity Control	Warmer surfaces and MVHR controls humidity from occupants and structure
Stale Air	MVHR provides continuous background
Uneven Heating	Fabric improvements reduce peak loads and temperature gradients

EnerPHit guidance identifies increased insulation and airtightness as measures that improve thermal comfort and reduce the risk of surface condensation and mould growth by increasing surface temperatures and controlling moisture (Taylor, 2011; Traynor, 2019).

10 Operational Energy, Carbon and Fuel Savings

The retrofit strategy prioritises retention and improvement of the existing structure rather than demolition and replacement. This is consistent with whole-life carbon thinking, which considers embodied carbon, operational carbon, maintenance, replacement and end-of-life impacts rather than only regulated energy use. The embodied carbon guidance frames design decisions around retention, reuse, recycling and whole-life impacts (Sturgis, 2017).

The existing LPG usage data provided by the client shows an extremely high energy usage for the size of the dwelling. The recorded LPG data indicates an annual energy expenditure of 35744.96 kWh/year with an average monthly cost of £255.92. This adds to an approximate annual cost of £3071.04.

The proposed retrofit strategy significantly reduces the dwelling's heat demand through fabric-first measures, including external wall insulation, roof and floor insulation, airtightness improvement, thermal-bridge reduction, high-performance glazing and MVHR. Following these improvements, the retrofit model proposes that both space heating and domestic hot water are supplied by an Aquarea J Series WH-UD05JE5 air source heat pump, replacing the existing LPG boiler as the primary heat source.

The modelled seasonal performance factor for the heat pump is 4.83, this means for every 1 kWh of electricity consumed, the heat pump generates approximately 4.83 kWh of heat (Vitoenergy 2024). Based on this the PHPP model identifies a final electrical energy demand of 1267 kWh/year.

Using the current Ofgem average electricity unit rate of 24.67p/kWh the estimated cost for heat generation is:

$$1267 \times £0.2467 = \mathbf{£312.54/year}$$

The estimated annual saving is therefore:

£3071.04-£312.54= **£2758.50**

This comparison demonstrates the significant operational benefit of combining deep retrofit with a high-efficiency heat pump.

11. Planning, Buildability and Risk

Underwood's location in the Gower AONB and its traditional appearance make planning and visual impact important. EWI will alter the wall thickness, reveals depth, eaves projection and window positioning. These changes will require planning permission due to its presence in a conservation area. Additionally, the proposed extension works should be integrated into the retrofit strategy rather than designed separately. Any new extension should conform to Enerphit standards from the outset to avoid creating potential fabric issues (Taylor, 2011; Traynor, 2019).

MVHR systems will need to be designed by a M&E consultant to specify ducting runs and sizes. Due to the age of the dwelling existing voids may be insufficient to run the necessary ducting, as such further alterations may be required to allow for installation of these systems (Passivhaus Trust, 2018; BSRIA, 2017).

12. Retrofit Phasing

Due to the extensive scope of a deep retrofit it is more feasible to undertake improvements in phases. The following phases should be implemented:

Phase	Associated Works
1	Carry out opening-up surveys, damp inspection, thermographic survey, drainage review, wall build-up confirmation, window schedule, roof inspection and airtightness leakage audit. Update the PHPP model with verified dimensions and materials.
2	Install EWI to suitable elevations, improve roof insulation, resolve plinth detailing, replace or reposition windows, and address thermal bridges. This phase should include all critical continuity details before finishes are applied.
3	Install the airtightness layer, seal penetrations, treat chimneys and service routes, and install MVHR. Undertake an intermediate airtightness test before finishes conceal the airtight layer.
4	Insulate the ground floor where disruption is acceptable. Recommission underfloor heating, reduce flow temperatures and assess the final heat load.
5	Replace LPG with an appropriately sized heat pump once the reduced heat load is confirmed. Review PV and/or solar thermal potential if planning and roof orientation allow.

6	Record energy use for at least 12 months post-retrofit, including internal temperature, humidity, MVHR filter maintenance, heating flow temperatures and electricity use. Update PHPP monitoring data to compare actual performance with design intent.
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13. Conclusion

Underwood currently has very high heating demand, driven by its original limestone construction, later cavity-wall extensions, poor floor performance, air leakage, thermal bridging and LPG heating. The PHPP baseline and recorded LPG use both confirm that a light-touch refurbishment would be insufficient.

The proposed fabric-first retrofit reduces modelled heating demand from 394.1 kWh/m²·a to 66.2 kWh/m²·a, an approximate 83% reduction. Although this does not meet the full EnerPHit heating-demand target, it provides a strong EnerPHit-informed pathway that responds to the constraints of the existing building.

The recommended strategy combines vapour-open EWI, roof and floor insulation, high-performance glazing, airtightness works, MVHR, thermal-bridge treatment and replacement of LPG with an Aquarea J Series ASHP. This reduces final electrical energy demand for heat generation to 1,267 kWh/year, with an estimated annual heating and hot water cost of £312.54, compared with the existing LPG cost of approximately £3,071.04/year.

Overall, the retrofit would significantly reduce energy use and running costs, improve comfort and indoor air quality, and protect the historic fabric. Further opening-up works, detailed junction design, structural input, planning review and updated PHPP modelling should be completed before construction.

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Appendices

Appendix A: PHPP Outputs

Specific energy demand for heating (annual method)

EnerPHit with PHPP Version 10.6 EN

Underwood / Climate: Swansea / TFA: 83 m² / Heating: 49 kWh/(m²a) / Overheating: 0 % / PER: 61.5 kWh/(m²a)

PHPP

Interior temperature: 20.0 °C
Building type: 1-Freestanding single family house
Treated floor area A_{TFA}: 83.0 m²

Transmission heat losses Q_T

Building assembly	Temperature zone	Area m²	U-value W/(m²K)	Temperature reduction factor	G _i kWh/a	kWh/a	Per m² of TFA
External wall - ambient	A	166.3	0.224	1.00	63.7	2379	28.66
External wall ground/basement	B			0.66			
Roof / ceiling - ambient	A	74.4	0.189	1.00	63.7	898	10.82
Floor slab / basement ceiling	B	68.9	0.229	0.66	63.7	667	8.03
	A			1.00			
	A			1.00			
	A			1.00			
Windows	A	17.9	0.765	1.00	63.7	873	10.52
Exterior door	A	1.7	0.740	1.00	63.7	81	0.97
Thermal bridges ambient (length/m)	A			1.00			0.00
Perimeter thermal bridges (length/m)	P			0.66			0.00
Thermal bridges ground (length/m)	B			0.66			0.00
Sum of all areas of the building envelope							kWh/(m²a)
329.3							59.0
Total transmission heat losses Q _T							4897

Ventilation heat losses Q_V

Reference volume for the ventilation system, V _V (A _{TFA} ·h)	m²	m	m³
	83.0	2.50	207.5
Ventilation system:			
Effective heat recovery efficiency of the heat exchanger	η _{eff}	86%	
Heat recovery efficiency of SHX	η _{SHX}	0%	
	n _{V,system}	η _{HR}	n _{V,Res}
	1/h		1/h
Energetically effective air changes n _V	0.445	(1 - 0.86)	0.071
	V _V	n _V	C _{air}
	m³	1/h	Wh/(m²K)
	207.5	0.132	0.33
			G _i
			kWh/a
			575
			6.9
Total ventilation heat losses Q _V			

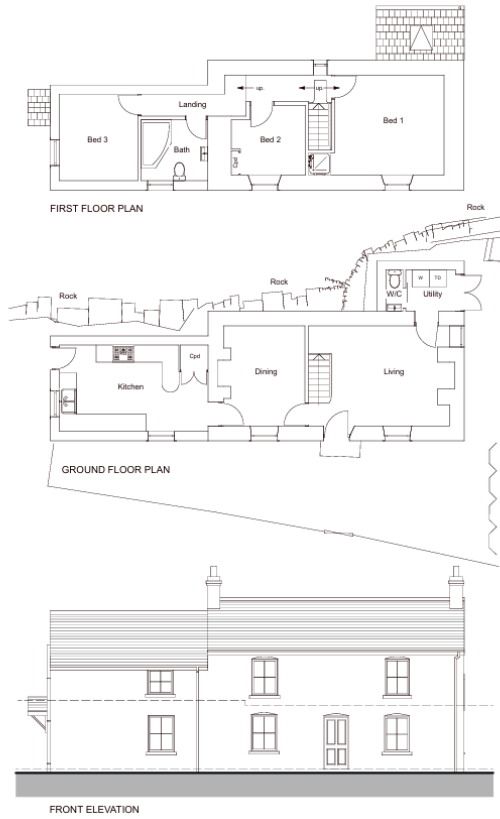
Total heat losses Q_L

(4897 + 575)	1.0	5472	65.9
Q _T	Q _V	Reduction factor	
kWh/a	kWh/a	night/weekend	
		lowering	

Results

Electrical energy consumption pump (ground water / brine)	Q _{El,Pump}	0	kWh/a
Electricity demand for heat supply direct electric	Q _{El,direct}	0	kWh/a
Electrical consumption of HP	Q _{El,HP}	1267	kWh/a
Space heat supplied by HP	Q _{HP,Heating}	4069	kWh/a
Winter DHW supplied by HP	Q _{HP,DHW,Winter}	1132	kWh/a
Summer DHW supplied by HP	Q _{HP,DHW,Summer}	916	kWh/a
Seasonal performance factor of heat pump	SPF _{H-1}	4.83	
Seasonal performance factor system	SPF _{H-3}	4.83	
Performance ratio of heat generator, space heating		21%	
Final electrical energy demand heat generation	Q _{final}	1267	kWh/a
		15.3	kWh/(m²a)
Annual PER demand (renewable primary energy)		2293	kWh/a
Annual PE demand (non-renewable primary energy)		1902	kWh/a
Annual CO ₂ -equivalent emissions		460	kg/a
		27.6	kWh/(m²a)
		22.9	kWh/(m²a)
		5.5	kg/(m²a)

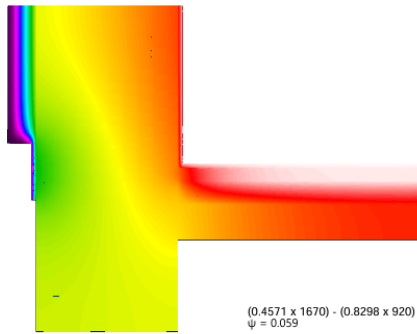
Appendix B – Existing Site Evidence



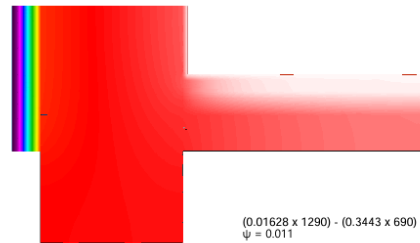
UNDERWOOD, PARKMILL
GOWER, SWANSEA
Mr & Mrs Brown
Scheme Design: Existing
Floor Plans & Elevations
Date: November 2022
Scale: 1:100 @ A3
Drawing Number: 2231-03



EWI Part Stone Wall.THM (9%) Therm Version 7.8.77.0 (1 of 1)



EWI Full Stone Wall.THM (9%) Therm Version 7.8.77.0 (1 of 1)



Underwood, Parkmill, SA3 2EH

LPG Usage Dec 23 - March 25

Fitted with 1410L tank (only allowed 85% fill)

05/12/2023	1132	0.549	£621.47	0.05	£31.07	£652.54
13/02/2024	1132	0.549	£621.47	0.05	£31.07	£652.54
09/05/2024	1089	0.549	£597.86	0.05	£29.89	£627.75
15/10/2024	830	0.549	£455.67	0.05	£22.78	£478.45
12/12/2024	1034	0.549	£567.67	0.05	£28.38	£596.05
14/02/2025	94	0.599	£56.31	0.05	£2.82	£59.12
17/03/2025	1158	0.599	£693.64	0.05	£34.68	£728.32

Total costs	£3,794.79
Monthly spend (/16months)	£237.17

Total Litres	6469	4851.75	Litre per annum
kWh conversion rate 1 litre		7.08	
convert LPG into kWh		34350.39	kWh per annum

square meters	90	381.671	kWh/m2a
---------------	----	---------	---------



IAN'S HOUSE / Edit

Account: **UW15D**

Results

Dwelling

Parameters

Equipment

Charts

Test Information

TEST DATE

19 Mar 2025 15:54

UPLOAD DATE

19 Mar 2025 15:55 by Matthew Drummond

LAST MODIFIED

-

TESTER NAME

Matthew Drummond

FILE NAME

2025-03-19_15.54.32_IANS_HOUSE.pat

TEST STATUS

Valid

WARNINGS

-

ACHIEVED PRESSURE

1.6 - 7.5 Pa

Measured Result @ 4Pa

AIR LEAKAGE RATE

Q4

536

m³/h

EFFECTIVE LEAKAGE AREA

0.06

m²

CALCULATION UNCERTAINTY

0.55

±%

AIR PERMEABILITY

AP4

2.12

m³/m²h

AIR CHANGES PER HOUR

N4

2.53

1/h

Extrapolated Result @ 50Pa

AIR LEAKAGE RATE

Q50

2,660

m³/h

EFFECTIVE LEAKAGE AREA

0.06

m²

CALCULATION UNCERTAINTY

1.70

±%

AIR PERMEABILITY

AP50

10.53

m³/m²h

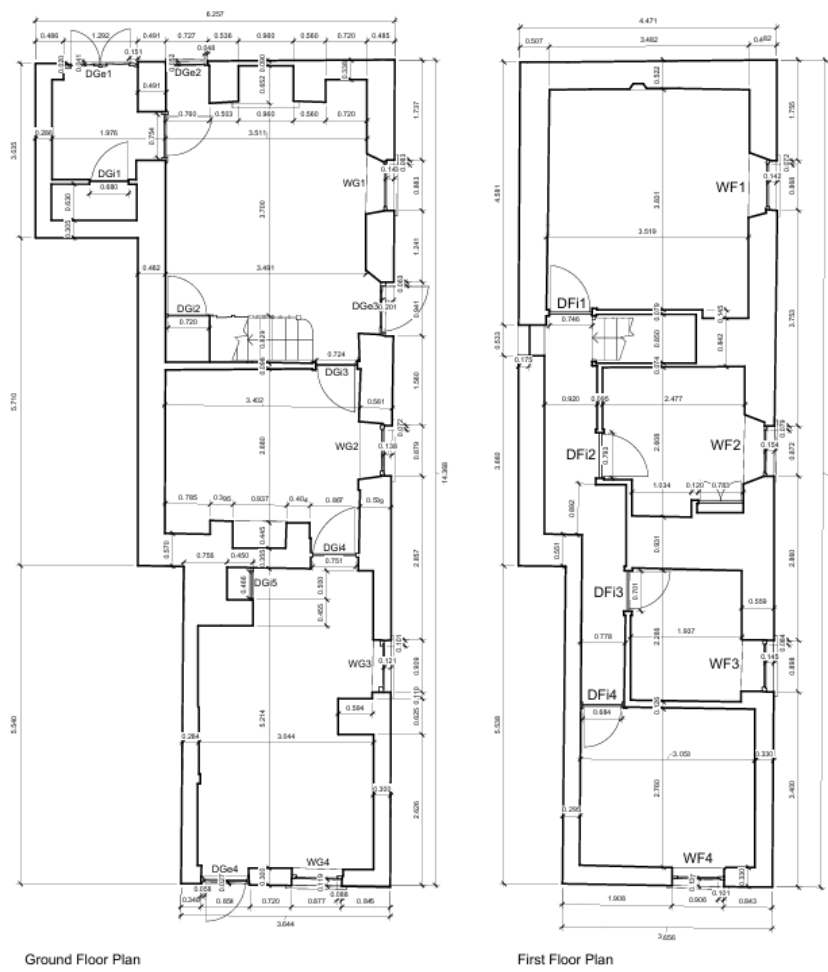
AIR CHANGES PER HOUR

N50

12.54

1/h

Floor Plans @ 1:50 A3



Ground Floor Plan

First Floor Plan

001

Appendices C: Product Specification Sheets

3.2 WH-ADC0309J3E5 WH-UD05JE5

Item		Unit	Outdoor Unit		
Performance Test Condition			EN 14511		
			EN 14825		
Cooling Capacity	Condition (Ambient/Water)	A35W7			
	kW	4.50			
	BTU/h	15300			
	kcal/h	3870			
Cooling EER	W/W	3.00			
	kcal/hW	2.58			
Heating Capacity	Condition (Ambient/Water)	A7W35	A2W35		
	kW	5.00	4.20		
	BTU/h	17100	14300		
	kcal/h	4300	3610		
Heating COP	W/W	5.00	3.18		
	kcal/hW	4.30	2.73		
Heating Erp	Low Temperature Application (W35)		Warmer	Average	Colder
	Application	Climate			
	Pdesign	kW	4.0	5.0	3.0
	Tbivalent/TOL	°C	2 / 2	-10 / -10	-20 / -22
	SCOP/ins	(W/W)%	6.20 / 245	5.07 / 200	4.00 / 157
	Annual Consumption	kWh	862	2038	1848
	Class		A++	A++	A++
	Medium Temperature Application (W55)		Warmer	Average	Colder
	Application	Climate			
	Pdesign	kW	4.0	4.0	2.0
	Tbivalent/TOL	°C	2 / 2	-10 / -10	-20 / -22
	SCOP/ins	(W/W)%	4.20 / 165	3.47 / 136	2.83 / 110
	Annual Consumption	kWh	1274	2385	1740
	Class		A++	A++	A+
	DHW		Warmer	Average	Colder
	Application	Climate			
	COP/rwh	(W/W)%	3.88 / 155	3.30 / 132	2.48 / 99
	AEC	kWh	640	760	994
Noise Level	Condition (Ambient/Water)	A35W7	A7W35	A2W35	
	dB (A)	Cooling: 48	Heating: 47		
	Power Level dB	Cooling: 64	Heating: 64 Heating: 55***		
Air Flow	m³/min (ft³/min)	Cooling: 39.6 (1400) Heating: 31.8 (1120)			
Refrigeration Control Device		Expansion Valve			
Refrigeration Oil	cm³	FW50S (450)			
Refrigerant	kg (oz)	R32, 0.90 (31.8) (Pre-charged) R32, 1.20 (42.4) (Maximum)			
F-GAS	GWP	675			
	CO ₂ eq (ton) (Precharged/Maximum)	0.808 / 0.810			
Dimension	Height	mm (inch)	622 (24-1/2)		
	Width	mm (inch)	824 (32-15/32)		
	Depth	mm (inch)	298 (11-24/32)		
Net Weight	kg (lbs)	37 (82)			

CELOTEX GA4000

Description

CELOTEX GA4000 is a rigid thermal insulation board made of polyisocyanurate (PIR) foam. The boards are provided on both sides with a low emissivity aluminium composite foil facing. **CELOTEX GA4000** is mainly used as thermal insulation in roof, wall and floor applications.

Packing & Storage

Thickness (mm)	Boards/pack	m ² /pack	Boards/pallet	m ² /pallet	Thermal resistance (R ₀) (m ² .K/W)
50	8	23,0	48	138,5	2,25
60	5	14,7	40	115,2	2,70
70	4	11,5	32	92,2	3,15
75	5	14,4	30	86,4	3,40
80	5	14,4	30	86,4	3,60
90	4	14,4	24	69,1	4,05
100	4	14,4	24	69,1	4,50

Store the boards on a flat surface, keep dry and protected from sunlight.

Characteristics

Thermal conductivity - λ_0 (W/(m.K)) (EN 12667)	50 ≤ d ≤ 100 mm	0,022
Length (mm) (EN 822)		2400 ± 10
Width (mm) (EN 822)		1200 ± 7,5
Thickness tolerance - Δh (EN 823)		T2
Density (kg/m ³)		NPD
Edge profile		straight
Compressive strength at 10 % deformation (kPa) (EN 826)		CS(10\Y)140
Dimensional stability (%) (EN 1604)		DS(70,90)3 DS(-20,-)1
Long term water absorption by total immersion (%) (EN 12087)		NPD
Reaction to fire (EN 13501-1)		F
Water vapour diffusion resistance - μ (EN 12086)		NPD
Tensile strength perpendicular to faces (kPa) (EN 1607)		NPD
Durability of compressive creep against ageing/degradation (kPa) (EN 1606)		NPD

NPD = no performance determined

Installation

Always consult the local regulations and contact the manufacturer for technical questions. Immediately after installation the insulation boards must be protected against weather conditions and sunlight.

Certifications

See certificate(s) for more information about the products, systems and specifications:

- BBA 17/5405 (UK)

Contact Soprema for more information.

Special indications

Hygiene, Health and Environment

The product does not contain any substance which is likely to be detrimental to your health or to the environment and complies with generally admitted Health and Safety Requirements.

Quality-, Environment- and Safety Management

SOPREMA always recognises as a high level of importance the quality of the products, the environment and safety. For this reason, we operate independently monitored Quality and Environment Assurance Systems in line with

EN ISO 9001 and **EN ISO 14001**.

Soprema Insulation Ltd T/A Celotex reserves the right to amend the composition of its material and consequently their prices, without prior notice. For this reason, all orders will be accepted only in accordance with the conditions and technical specifications in force at the date of order.

Contact: www.celotex.co.uk



TDS-UK-INSUK0003.P/EN

CELOTEX PL4000

Description

CELOTEX PL4000 is a rigid thermal insulation board made of polyisocyanurate (PIR) foam. The boards are provided with a paper facing, laminated on one side to a piece of 12,5 mm tapered edge plasterboard. **CELOTEX PL4000** is mainly used as thermal insulation in roof and internal wall lining applications.

Packing & Storage

Thickness (mm)	Boards/ pallet	m ² /pallet	Thermal resistance (R ₀) (m ² .K/W) ¹
25+12,5	52	149,8	1,20
40+12,5	44	126,7	1,85
50+12,5	36	103,7	2,30
60+12,5	32	92,2	2,75
65+12,5	28	80,6	3,00

¹ Value determined on total board

Store the boards on a flat surface, keep dry and protected from sunlight.

Characteristics

Thermal conductivity insulation - λ_D (W/(m.K)) (EN 12667)	25 ≤ d ≤ 65 mm	0,022
Length (mm) (EN 822)		2400 ± 10
Width (mm) (EN 822)		1200 ± 7,5
Thickness tolerance - Δx (mm) (EN 823)		$\Delta x \pm 3$
Density (kg/m ³)		NPD
Edge profile		straight with tapered edge plasterboard
Compressive strength at 10% deformation (kPa) (EN 826)		NPD
Dimensional stability (%) (EN 1604)		NPD
Long term water absorption by total immersion (%) (EN 12087)		NPD
Reaction to fire (EN 13501-1)		B-s1, d0
Water vapour diffusion resistance - μ (EN 12086)		NPD
Tensile strength perpendicular to faces (kPa) (EN 1607)		NPD
Durability of compressive creep against ageing/degradation (kPa) (EN 1606)		NPD

NPD = no performance determined

Installation

Always consult the local regulations and contact the manufacturer for technical questions. Immediately after installation the insulation boards must be protected against weather conditions and sunlight.

Certifications

See certificate(s) for more information about the products, systems and specifications:
- **BBA 16/5357 (UK)**
Contact Soprema for more information.

Special indications

Hygiene, Health and Environment

The product does not contain any substance which is likely to be detrimental to your health or to the environment and complies with generally admitted Health and Safety Requirements.

Quality-, Environment- and Safety Management

SOPREMA always recognises as a high level of importance the quality of the products, the environment and safety. For this reason, we operate independently monitored Quality and Environment Assurance Systems in line with **EN ISO 9001** and **EN ISO 14001**.

Soprema Insulation Ltd T/A Celotex reserves the right to amend the composition of its material and consequently their prices, without prior notice. For this reason, all orders will be accepted only in accordance with the conditions and technical specifications in force at the date of order.

Contact: www.celotex.co.uk



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**Agrément Certificate****19/5613**

Product Sheet 1

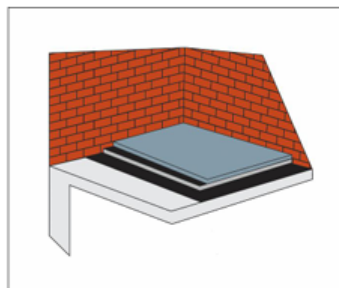
LIGNOFOL DAMP-PROOF MEMBRANE**LIGNOFOL 250, 300, AND 500 DAMP-PROOF MEMBRANES**

This Agrément Certificate Product Sheet⁽¹⁾ relates to Lignofol 250, 300, and 500 Damp-Proof Membranes, polyethylene film membranes for use in solid concrete ground floors not subject to hydrostatic pressure, to protect buildings against moisture from the ground.

(1) Hereinafter referred to as 'Certificate'.

CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

**KEY FACTORS ASSESSED**

Resistance to water and water vapour — the membranes, including joints, will resist the passage of moisture into the structure (see section 6).

Resistance to puncture — the membranes have a high resistance to puncture and on a smooth or blinded surface will not be damaged by foot or site traffic (see section 7).

Durability — under normal service conditions, the membranes will provide an effective barrier to the transmission of moisture for the life of the structure in which they are incorporated (see section 10).



The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Second issue: 7 May 2021

Originally certificated on 16 January 2019

Hardy Giesler
Chief Executive Officer

The BBA is a UKAS accredited certification body – Number 113.
The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk
Readers MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.
Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

British Board of Agrément

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Watford
Herts WD25 9BA

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tel: 01923 665300
clientservices@bbacerts.co.uk
www.bbacerts.co.uk

EWI-747

LIME RENDER NHL 3.5

EWI-747 Lime Render is the flagship product in the Heritage Range. One of the primary reasons for using lime render is breathability. The breathability of lime render refers to its ability to allow water vapour to pass through its structure, facilitating the movement of moisture in and out of a building's walls. This permeability is a crucial characteristic of lime render, providing several advantages over less breathable materials, such as cement-based renders.

Crucially, lime-based products marry well with our eco-friendly, sustainable policy; with no chemical additives, our Heritage Range is completely natural and aesthetically timeless. Perfectly suited to the renovation of older buildings, the Heritage Range sets through carbonation, which means it actively absorbs CO₂.

Intended Uses.

Ideal for plastering and plastering on brick, stone or mud walls indoors and outdoors. Especially ideal for works where the use of traditional, highly breathable, more durable and sustainable materials is required.



Technical Specification

Appearance

Dry powder, Off-white (grey)

Compressive strength

Category CS II (at 28 days)

Reaction to fire

Class A1

Humidity level

80% RH

Water absorption

WD

Water vapour permeability coefficient

$\mu \leq 6$



BREATHABLE



A1 FIRE RATED



ANTI-BACTERIAL
& ANTI-FUNGAL



ECO-FRIENDLY



ABSORBS CO₂



SPRAY OR
HAND-APPLIED

CERTIFICATE

Certified Passive House Component

Component-ID 0978wi03 valid until 31st December 2021

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
Germany

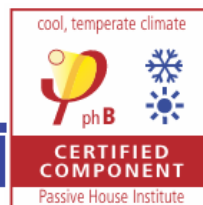
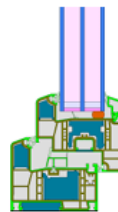


Category: **Window Frame**
Manufacturer: **REHAU Construction LLC,**
Leesburg, Virginia 20176,
United States of America
Product name: **GENEO Passive House**

This certificate was awarded based on the following
criteria for the cool, temperate climate zone

Comfort $U_W = 0.78 \leq 0.80 \text{ W/(m}^2 \text{ K)}$
 $U_{W, \text{installed}} \leq 0.85 \text{ W/(m}^2 \text{ K)}$
with $U_g = 0.70 \text{ W/(m}^2 \text{ K)}$

Hygiene $f_{\text{Rel}=0.25} \geq 0.70$





NyRock® Rainscreen 032

Low lambda non-combustible stone wool insulation for ventilated facades.

NyRock® Rainscreen 032 is a stone wool insulation product specifically developed for use within ventilated cladding systems, as well as sealed systems such as curtain walling.

Manufactured using patented technology, NyRock Rainscreen 032 has a fibre structure that increases the density of air pockets trapped within each slab. This results in an improved thermal performance when compared to traditional stone wool products.

Once installed, the product's high density works in combination with a factory-applied water repelling agent to provide resistance to rain ingress during construction.



Low lambda non-combustible insulation for use within facade systems.

NyRock Rainscreen 032 is manufactured using patented NyRock technology for low lambda performance. In addition to thermal comfort, NyRock Rainscreen 032 provides independently-tested acoustic benefits.

For more information visit rockwool.com/uk

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CERTIFICATE

Certified Passive House Component

Component-ID 1194ws02 valid until 31st December 2022

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
Germany



Category: **Window system**
Manufacturer: **ENERSign GmbH,
Wittlich,
Germany**
Product name: **ENERSign primus**

**This certificate was awarded based on the following
criteria for the cold climate zone**

Comfort $U_W = 0.60 \leq 0.60 \text{ W/(m}^2 \text{ K)}$
 $U_{W, \text{installed}} \leq 0.65 \text{ W/(m}^2 \text{ K)}$
with $U_g = 0.52 \text{ W/(m}^2 \text{ K)}$

Hygiene $f_{Rsi=0.25} \geq 0.75$
Airtightness $Q_{100} = 0.16 \leq 0.25 \text{ m}^3/(\text{h m})$



Composite Doors AGILA

- 1 Dedicated transom allows for top light glazing and greater flexibility
- 2 Opening vent option using REHAU Tritec sash
- 3 Slimmer sightlines enabling narrower door openings such as small cottage doors and older properties
- 4 Suitable for standard 44mm door slabs
- 5 Mechanical joint option available on transom
- 6 Dual brush pile seal for enhanced weather performance

Feature	Specification
Profile depth	70mm
Maximum slab weight	100kg
Maximum door size	996 x 2105mm
Panel width	44mm
Further options	Dedicated low threshold options for Part M compliance
	Mechanical joint
	Dedicated frame and transom
Accreditations	See page 60





ROCKWOOL Roll, Twin Roll and Rollbatt

Thermal and acoustic solutions for roof and loft spaces.

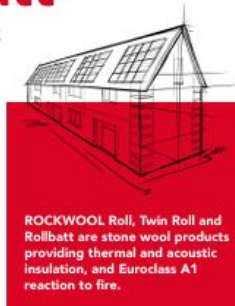
ROCKWOOL provides three variations of roll to deliver products for a variety of building types and loft spaces.

ROCKWOOL Roll consists of a single thickness of 1200mm wide roll, which can be cut to fit as required.

Twin Roll is pre-split into two 100mm thick layers in a pack. 100mm is installed between the rafters, and then 200mm over the rafters.

Rollbatt is pre-split into either two 600mm widths, or three 400mm widths.

- Thermal conductivity of 0.044 W/mK.
- Non-combustible – Euroclass A1 classification as defined in EN 13501-1: 2018.
- Multi-application for roof and loft spaces.
- Available as a complete roll, pre-cut widths, or pre-split.



For more information visit rockwool.com/uk

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CELOTEX XPS 300 SL FN

Description

CELOTEX XPS 300 SL FN is a rigid thermal insulation board made of extruded polystyrene (XPS) foam produced according to climate-friendly CO₂ technology.

CELOTEX XPS 300 SL FN is mainly used as thermal insulation including pitched and inverted roofs, floors and underground constructions. In case of inverted roofs the system must be ballasted.

Packing & Storage

Thickness (mm)	Boards/ pack	m ² /pack	Boards/pallet	m ² /pallet	Thermal resistance (R ₀) (m ² .K/W) ⁽¹⁾
1250 x 600 mm ⁽¹⁾					
40	10	7,5	120	90,0	1,25
50	8	6,0	96	72,0	1,55
60	7	5,3	84	63,0	1,85
80	5	3,8	60	45,0	2,50
100	4	3,0	48	36,0	3,10
120	3	2,3	42	31,5	3,75
140	3	2,3	36	27,0	4,35
160	2	1,5	32	24,0	5,00
180	2	1,5	28	21,0	5,60
200	2	1,5	24	18,0	6,25
220	2	1,5	20	15,0	6,85
240	2	1,5	20	15,0	7,50
260	1	0,8	18	13,5	7,85
280	1	0,8	16	12,0	8,45
2500 x 600 mm ⁽²⁾					
40	10	15,0	120	180,0	1,25
50	8	12,0	96	144,0	1,55
60	7	10,5	84	126,0	1,85
80	5	7,5	60	90,0	2,50
100	4	6,0	48	72,0	3,10
120	3	4,5	42	63,0	3,75
140	3	4,5	36	54,0	4,35
160	2	3,0	32	48,0	5,00
180	2	3,0	28	42,0	5,60
200	2	3,0	24	36,0	6,25
220	2	3,0	20	30,0	6,85
240	2	3,0	20	30,0	7,50
260	1	1,5	18	27,0	7,85
280	1	1,5	16	24,0	8,45

⁽¹⁾ In addition to the default pallet, there is also a "jumbo" pack, composed of 2x2 pallets.

⁽²⁾ In addition to the default pallet, there is also a "jumbo" pack, composed of 2x1 pallets.

⁽³⁾ The variation due to aging of the thermal conductivity and resistance has been taken into account in the indicated performance

Store the insulation boards on a flat surface, keep dry, protected from sunlight and temperatures above 75 °C.

SOPREMA reserves the right to amend the composition of its material and consequently their prices, without prior notice. For this reason, all orders will be accepted only in accordance with the conditions and technical specifications in force at the date of order.

Contact: www.soprema.com



TDS-UK-INSUK0008-2020

Certificate

Certified Passive House Component

for cold climates; valid until 31.12.2014

Category: **Roof Window**
 Manufacturer: **VELUX A/S**
 2970 Hørsholm, DENMARK
 Product name: **GGU -K-- 008230**

This certificate was awarded based on the following criteria:

Given a U_g value of $0.3840 \text{ W/(m}^2\text{K)}$ and a window size of 1.14 m by 1.40 m,

$$U_{RW} = 0.55 \text{ W/(m}^2\text{K)} \leq 0.70 \text{ W/(m}^2\text{K)}$$

Taking into account the installation based thermal bridges and provided that the installation is, with regard to the thermal bridges, equal or better than shown in the data sheet, the roof window meets the following criterion.

$$U_{RW, \text{installed}} \leq 0.70 \text{ W/(m}^2\text{K)}$$

Thermal data

	U_f -value [W/(m ² K)]	Width [mm]	Ψ_g [W/(mK)]	$f_{Rsi=0.25}$ [-]
Spacer			TGI*	
Bottom	0.71	123	0.019	0.77
Side oPV	0.74	106	0.025	0.78
Side uPV	0.73	106	0.025	0.78
Top	0.61	116	0.025	0.80

*Spacers of lower thermal quality, especially those made of aluminium, lead to significantly higher thermal losses and lower temperature factors.

For further information, please see the data sheet

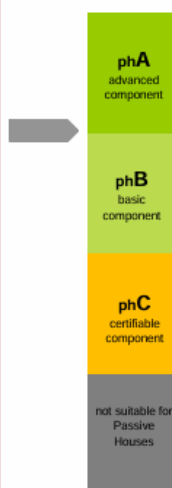
www.passivehouse.com

0592rw02

Passive House Institute
 Dr. Wolfgang Feist
 64283 Darmstadt
 GERMANY



Passive House Efficiency Class



CERTIFIED COMPONENT

Passive House Institute

CERTIFICATE

Certified Passive House Component

Component-ID 0954vs03 valid until 31st December 2026

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
Germany



Category: **Air handling unit with heat recovery**
Manufacturer: **Zehnder Group Nederland B.V.**
Netherlands
Product name: **ComfoAir Q450 HRV, Comfort Vent Q450 HRV**

Specification: Airflow rate < 600 m³/h
Heat exchanger: Recuperative

This certificate was awarded based on the product meeting the following main criteria

Heat recovery rate η_{HR} $\geq$ 75 %
Specific electric power $P_{el,spec}$ $\leq$ 0.45 Wh/m³
Leakage $<$ 3 %
Comfort Supply air temperature $\geq$ 16.5 °C at outdoor air temperature of -10 °C

Airflow range

70–345 m³/h

Heat recovery rate

η_{HR} = 88 %

Specific electric power

$P_{el,spec}$ = 0.21 Wh/m³

¹⁾ At an airflow of 89 m³/h, a heat recovery of η_{HR} = 94 % is reached.
Due to the frost protection strategy at outdoor temperatures of -15 °C the air flow rate is reduced to about 255 m³/h.

cool, temperate climate



**CERTIFIED
COMPONENT**

Passive House Institute

www.passivehouse.com