

Back to Earth SW Ltd

7 Tuns Lane
Silverton
Exeter
EX5 4HY

Project Information

Reference

Date 20 November 2023

Construction Type

Element : Flat roof - Roof-flat-vented-150mm

Internal surface emissivity : High External surface emissivity : High

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m ² K/W)	Pitch (°)	Bridge details Air gaps (Level, Delta U")
Outside surface resistance	-	-	0.100		
EPDM (ethylene propylene diene monomer)	1.0	0.250	0.004		
Plywood (500 kg/m ³)	18.0	0.130	0.138		
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.160		
Ampatop Protecta	-	-	-		
Beltermo Ultra	120.0	0.042	2.850		L:0 0.000W/m ² K
SteicoFlex	150.0	0.036	4.150		9.000% Softwood (150.0mm) L:0 0.000W/m ² K
Fermacell	10.0	0.320	0.031		
Ampatex DB90	-	-	-		
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160		
Gyproc Wallboard	12.5	0.190	0.066		
Inside surface resistance	-	-	0.100		

Total thickness 386.5mm

U-value = 0.14W/m²K

U-value, Combined Method : 0.140W/m²K (upper/lower limit 7.344 / 6.973m²K/W, dUf 0.0038, dUg 0.0000, dUp0.0000, dUr0.0000, dUrc1 0.0000, dUrc2 0.0000)

Correction factors

Mechanical fasteners :-

Warm pitched roof - insulation over rafters

Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 6.700 per m² Af : 12.500mm² Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0038

nf = fasteners per m² Af = fasteners cross-sectional area

Air gaps, Delta Ug = 0.000W/m²K

(Based on the combined method for determining U-values of structures containing repeating thermal bridges)

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m ² K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
EPDM (ethylene propylene diene monomer)	1.0	0.250	0.004	30000.00	30.00
Plywood (500 kg/m ³)	18.0	0.130	0.138	1000.00	18.00
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.160	-	0.00
Ampatop Protecta	-	-	-	-	0.50
Beltermo Ultra	120.0	0.042	2.850	15.00	1.80
SteicoFlex	150.0	0.036	4.150	5.00	0.75
Fermacell	10.0	0.320	0.031	65.00	0.65
Ampatex DB90	-	-	-	-	100.00
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160	-	0.00
Gyproc Wallboard	12.5	0.190	0.066	50.00	0.63
Inside surface resistance	-	-	0.100	-	-
Total thickness	386.5mm				

Detailed U-value Calculation Results

Construction includes 1 bridged layer

Non-bridged layers

Outside surface resistance	0.100 m ² K/W
EPDM (ethylene propylene diene monomer)	0.004 m ² K/W
Plywood (500 kg/m ³)	0.138 m ² K/W
Airspace, heat flow upwards, 50 mm thick	0.160 m ² K/W
Beltermo Ultra	2.850 m ² K/W
Fermacell	0.031 m ² K/W
Airspace, heat flow upwards, 25 mm thick	0.160 m ² K/W
Gyproc Wallboard	0.066 m ² K/W
Inside surface resistance	0.100 m ² K/W
<u>Resistance of non-bridged layers, R_{NB} =</u>	<u>3.609 m²K/W</u>

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex
Path 2 - Softwood

Resistance and fraction of heat flow paths

$$R_{P1} = R_{NB} + R_{L1} = 3.609 + 4.150 = 7.759 \text{ m}^2\text{K/W} \quad F_{P1} = 91.000\%$$

$$R_{P2} = R_{NB} + R_{L2} = 3.609 + 1.154 = 4.763 \text{ m}^2\text{K/W} \quad F_{P2} = 9.000\%$$

Upper resistance limit

$$R_{upper} = 1 / \left(\frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} \right)$$
$$R_{upper} = 1 / \left(\frac{0.910}{7.759} + \frac{0.090}{4.763} \right) = 7.344 \text{ m}^2\text{K/W}$$

Lower resistance limit

$$R_{lower} = R_{NB} + 1 / \left(\frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right)$$
$$R_{lower} = 3.609 + 1 / \left(\frac{0.910}{4.150} + \frac{0.090}{1.154} \right) = 6.973 \text{ m}^2\text{K/W}$$

Total resistance of roof

$$R_T = (R_{upper} + R_{lower}) / 2 = (7.344 + 6.973) / 2 = 7.16 \text{ m}^2\text{K/W}$$

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Warm pitched roof - insulation over rafters

Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 6.700 per m² Af : 12.500mm² Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0038

Correction for air gaps, Delta Ug = 0.0000W/m²K

(Delta Uf + Delta Ug + Delta Up + Delta Ur) is less than 3% of (1 / Rt) so U = (1 / Rt) + (Delta Ur) + (Delta Urc) = 0.14 W/m²K

Structure element : Flat roof
 Condensation calculations performed in accordance with BS5250:2021

Condensation is occurring at the following layers interfaces:-

Interface 1 : Plywood (500 kg/m³) / Airspace, heat flow upwards, 50 mm thick

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)	Interface 1 Gc (Kg/m ²)	Ma (Kg/m ²)
Jan	20.00	47.90	3.10	85.00	0.00041	0.00041
Feb	20.00	47.40	3.10	83.50	-0.00048	0.00000
Mar	20.00	48.30	5.20	79.50	0.00000	0.00000
Apr	20.00	49.70	7.60	75.50	0.00000	0.00000
May	20.00	54.70	10.60	76.00	0.00000	0.00000
Jun	20.00	60.90	14.00	74.50	0.00000	0.00000
Jul	20.00	65.80	15.80	75.00	0.00000	0.00000
Aug	20.00	66.60	15.40	77.50	0.00000	0.00000
Sep	20.00	62.30	13.20	79.50	0.00000	0.00000
Oct	20.00	57.30	10.00	83.00	0.00000	0.00000
Nov	20.00	51.10	6.00	84.00	0.00000	0.00000
Dec	20.00	49.30	4.20	85.50	0.00000	0.00000

Gc = Monthly moisture accumulation per area at an interface

Ma = Accumulated moisture content per area at an interface

Peak accumulated moisture content per area at interface (Ma) = 0.00041 Kg/m²

Annual moisture accumulation = 0.00000 Kg/m²

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Thermal Mass Details

	Thickness assessed (actual) (mm)	Density (kg/m ³)	Specific heat capacity (J/kgK)	Heat capacity (kJ/m ² K)
EPDM (ethylene propylene diene monomer)	0.0 (1.0)	1150.0	1000.0	0.0
Plywood (500 kg/m ³)	0.0 (18.0)	500.0	1600.0	0.0
Airspace, heat flow upwards, 50 mm thick	0.0 (50.0)	1.2	1008.0	0.0
Ampatop Protecta	0.0 (-)	300.0	850.0	0.0
Beltermo Ultra	0.0 (120.0)	180.0	2100.0	0.0
SteicoFlex	0.0 (150.0)	60.0	2100.0	0.0
Fermacell	10.0 (10.0)	1150.0	1000.0	11500000.0
Ampatex DB90	0.0 (-)	280.0	850.0	0.0
Airspace, heat flow upwards, 25 mm thick	25.0 (25.0)	1.2	1008.0	30996.0
Gyproc Wallboard	12.5 (12.5)	0.0	0.0	0.0
Total				11530996.0
kappa value				11.5310
Limiting condition:	insulation			

Admittance : 1.11 W/m²K Decrement : 0.15 factor Decrement delay : -14.42 hours

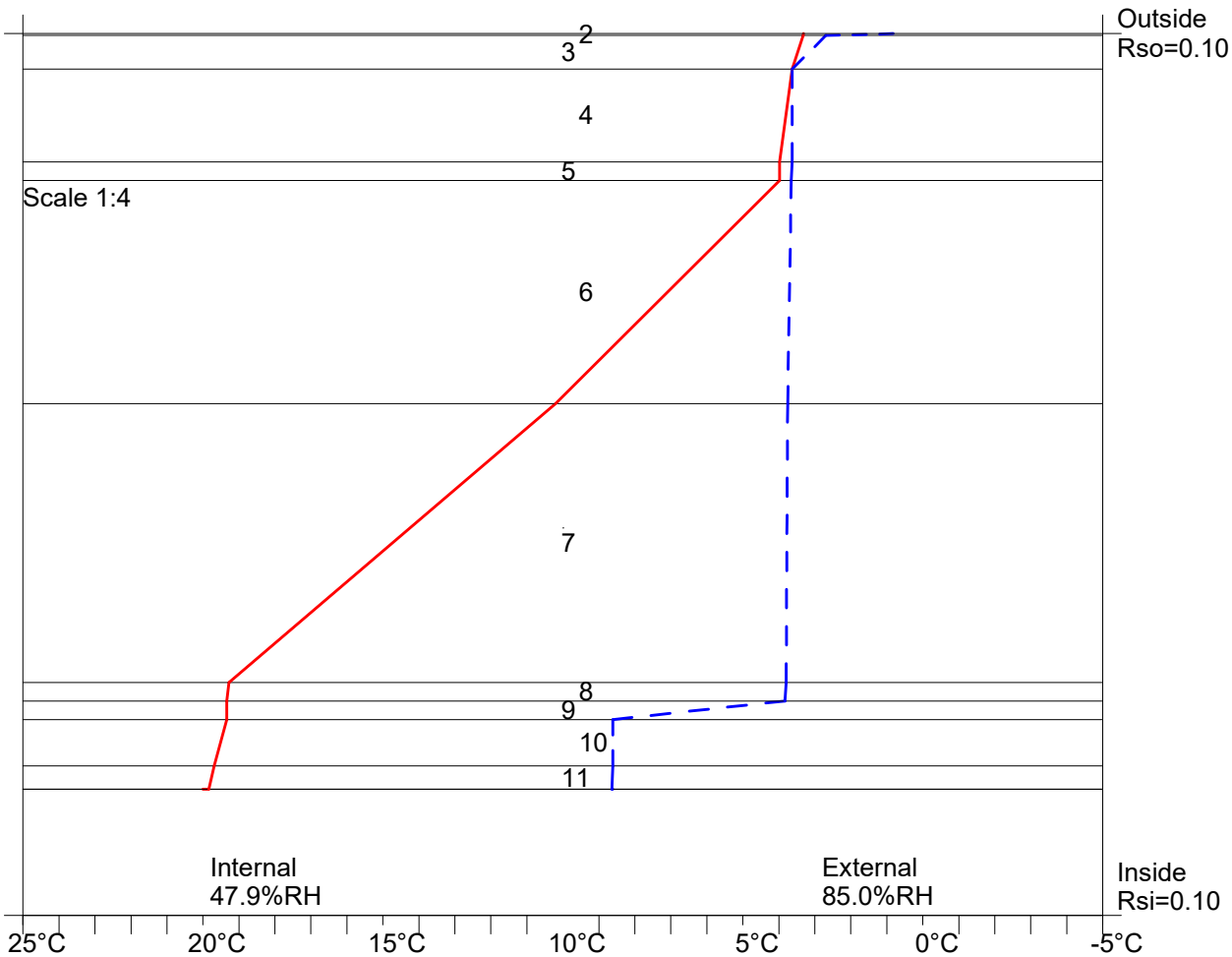
Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, shops and dwellings with low occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 47.9%	20.0C 47.4%	20.0C 48.3%	20.0C 49.7%	20.0C 54.7%	20.0C 60.9%	20.0C 65.8%	20.0C 66.6%	20.0C 62.3%	20.0C 57.3%	20.0C 51.1%	20.0C 49.3%
3.1C 85.0%	3.1C 83.5%	5.2C 79.5%	7.6C 75.5%	10.6C 76.0%	14.0C 74.5%	15.8C 75.0%	15.4C 77.5%	13.2C 79.5%	10.0C 83.0%	6.0C 84.0%	4.2C 85.5%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m ²)	Peak Buildup (g/m ²)	Condensation
1 Outside surface resistance							
2 EPDM (ethylene propylene diene monomer)	3.3	0.8	0.65	0.77			No
3 Plywood (500 kg/m ³)	3.3	2.7	0.74	0.78			No
4 Airspace, heat flow upwards, 50 mm thick	3.6	3.6	0.79	0.79	0.4 in Jan	0 in Jan	Yes
5 Ampatop Protecta	4.0	3.6	0.79	0.81			No
6 Beltermo Ultra	4.0	3.7	0.79	0.81		0 in Jan	No
7 SteicoFlex	10.2	3.8	0.80	1.24			No
8 Fermacell	19.3	3.8	0.80	2.23			No
9 Ampatex DB90	19.3	3.8	0.80	2.24			No
10 Airspace, heat flow upwards, 25 mm thick	19.3	8.6	1.12	2.24			No
11 Gyproc Wallboard	19.7	8.6	1.12	2.29			No
12 Inside surface resistance	19.8	8.6	1.12	2.31			No

Worst case internal / external conditions for graph : 20.0°C @ 47.9%RH / 3.1°C @ 85.0%RH



Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, shops and dwellings with low occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 47.9%	20.0C 47.4%	20.0C 48.3%	20.0C 49.7%	20.0C 54.7%	20.0C 60.9%	20.0C 65.8%	20.0C 66.6%	20.0C 62.3%	20.0C 57.3%	20.0C 51.1%	20.0C 49.3%
3.1C 85.0%	3.1C 83.5%	5.2C 79.5%	7.6C 75.5%	10.6C 76.0%	14.0C 74.5%	15.8C 75.0%	15.4C 77.5%	13.2C 79.5%	10.0C 83.0%	6.0C 84.0%	4.2C 85.5%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m ²)	Peak Buildup (g/m ²)	Condensation
1 Outside surface resistance							
2 EPDM (ethylene propylene diene monomer)	15.9	11.4	1.35	1.80			No
3 Plywood (500 kg/m ³)	15.9	11.8	1.38	1.80			No
4 Airspace, heat flow upwards, 50 mm thick	15.9	12.1	1.41	1.81	0.4 in Jan	0 in Jan	Yes
5 Ampatop Protecta	16.0	12.1	1.41	1.82			No
6 Beltermo Ultra	16.0	12.1	1.41	1.82		0 in Jan	No
7 SteicoFlex	17.6	12.1	1.41	2.01			No
8 Fermacell	19.8	12.1	1.41	2.31			No
9 Ampatex DB90	19.8	12.1	1.41	2.31			No
10 Airspace, heat flow upwards, 25 mm thick	19.8	13.4	1.54	2.31			No
11 Gyproc Wallboard	19.9	13.4	1.54	2.33			No
12 Inside surface resistance	20.0	13.4	1.54	2.33			No

Worst case internal / external conditions for graph : 20.0°C @ 65.8%RH / 15.8°C @ 75.0%RH

