

## 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-single ply-150mm

Internal surface emissivity : High External surface emissivity : High

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m <sup>2</sup> K/W)	Pitch (°)	Bridge details Air gaps (Level, Delta U")
Outside surface resistance	-	-	0.040		
EPDM (ethylene propylene diene monomer)	1.0	0.250	0.004		
Plywood (500 kg/m <sup>3</sup> )	18.0	0.130	0.138		
Beltermo Ultra	100.0	0.042	2.350		L:0 0.000W/m <sup>2</sup> K
SteicoFlex	150.0	0.036	4.150		9.000% Softwood (150.0mm) L:0 0.000W/m <sup>2</sup> K
Fermacell	10.0	0.320	0.031		
Ampatex Variano	-	-	-		
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160		
Gyproc Wallboard	12.5	0.190	0.066		
Inside surface resistance	-	-	0.100		
<b>Total thickness</b>	<b>316.5mm</b>				

### U-value = 0.16W/m<sup>2</sup>K

U-value, Combined Method : 0.156W/m<sup>2</sup>K (upper/lower limit 6.599 / 6.253m<sup>2</sup>K/W, dUf 0.0037, 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 m<sup>2</sup> Af : 12.500mm<sup>2</sup> Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0037

nf = fasteners per m<sup>2</sup> Af = fasteners cross-sectional area

Air gaps, Delta Ug = 0.000W/m<sup>2</sup>K

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

## Detailed U-value Calculation Results

Construction includes 1 bridged layer

### Non-bridged layers

Outside surface resistance	0.040 m <sup>2</sup> K/W
EPDM (ethylene propylene diene monomer)	0.004 m <sup>2</sup> K/W
Plywood (500 kg/m <sup>3</sup> )	0.138 m <sup>2</sup> K/W
Beltermo Ultra	2.350 m <sup>2</sup> K/W
Fermacell	0.031 m <sup>2</sup> K/W
Airspace, heat flow upwards, 25 mm thick	0.160 m <sup>2</sup> K/W
Gyproc Wallboard	0.066 m <sup>2</sup> K/W
Inside surface resistance	0.100 m <sup>2</sup> K/W
Resistance of non-bridged layers, R <sub>NB</sub> =	<u>2.889 m<sup>2</sup>K/W</u>

### Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex

Path 2 - Softwood

### Resistance and fraction of heat flow paths

$$R_{P1} = R_{NB} + R_{L1} = 2.889 + 4.150 = 7.039 \text{ m}^2\text{K/W} \quad F_{P1} = 91.000\%$$

$$R_{P2} = R_{NB} + R_{L2} = 2.889 + 1.154 = 4.043 \text{ m}^2\text{K/W} \quad F_{P2} = 9.000\%$$

### Upper resistance limit

$$R_{\text{upper}} = 1 / \left( \frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} \right)$$

$$R_{\text{upper}} = 1 / \left( \frac{0.910}{7.039} + \frac{0.090}{4.043} \right) = 6.599 \text{ m}^2\text{K/W}$$

### Lower resistance limit

$$R_{\text{lower}} = R_{NB} + 1 / \left( \frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right)$$

$$R_{\text{lower}} = 2.889 + 1 / \left( \frac{0.910}{4.150} + \frac{0.090}{1.154} \right) = 6.253 \text{ m}^2\text{K/W}$$

### Total resistance of roof

$$R_T = \left( R_{\text{upper}} + R_{\text{lower}} \right) / 2 = (6.599 + 6.253) / 2 = 6.43 \text{ m}^2\text{K/W}$$

### 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 m<sup>2</sup>    Af : 12.500mm<sup>2</sup>    Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0037

Correction for air gaps, Delta Ug = 0.0000W/m<sup>2</sup>K

(Delta Uf + Delta Ug + Delta Up + Delta Ur) is less than 3% of (1 / Rt) so U = (1 / Rt) + (Delta Ur) + (Delta Urc) = 0.16 W/m<sup>2</sup>K

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**Thermal Mass Details**

	Thickness assessed (actual) (mm)	Density (kg/m <sup>3</sup> )	Specific heat capacity (J/kgK)	Heat capacity (kJ/m <sup>2</sup> K)
EPDM (ethylene propylene diene monomer)	0.0 (1.0)	1150.0	1000.0	0.0
Plywood (500 kg/m <sup>3</sup> )	0.0 (18.0)	500.0	1600.0	0.0
Beltermo Ultra	0.0 (100.0)	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 Variano	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 : 1.12 W/m<sup>2</sup>K    Decrement : 0.23 factor    Decrement delay : -12.42 hours