

## Back to Earth SW Ltd

7 Tuns Lane  
Silverton, Exeter  
Devon. EX5 4HY

### Project Information

Reference

Date 14 September 2018

### Construction Type

Element : Flat roof - 0 Spec generator copies

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	-	-	0.100		
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.006		
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	200.0	0.036	5.550		9.000% Softwood (200.0mm) L:0 0.000W/m <sup>2</sup> K
Ampatex Variano	-	-	-		
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160		
Gyproc Wallboard	12.5	0.189	0.066		
Inside surface resistance	-	-	0.100		
<b>Total thickness</b>	<b>357.0mm</b>				

### U-value = 0.13W/m<sup>2</sup>K

U-value, Combined Method : 0.131W/m<sup>2</sup>K (upper/lower limit 7.836 / 7.416m<sup>2</sup>K/W, dUf 0.0000, dUg 0.0000, dUp0.0000, dUr0.0000, dUrc1 0.0000, dUrc2 0.0000)

### Correction factors

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)

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m <sup>2</sup> K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.006	30000.00	45.00
Plywood (500 kg/m <sup>3</sup> )	18.0	0.130	0.138	1000.00	18.00
Beltermo Ultra	100.0	0.042	2.350	15.00	1.50
SteicoFlex	200.0	0.036	5.550	5.00	1.00
Ampatex Variano	-	-	-	-	21.00
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160	-	0.00
Gyproc Wallboard	12.5	0.189	0.066	50.00	0.63
Inside surface resistance	-	-	0.100	-	-
<b>Total thickness</b>	<b>357.0mm</b>				

## Detailed U-value Calculation Results

Construction includes 1 bridged layer

### Non-bridged layers

Outside surface resistance	0.100 m <sup>2</sup> K/W
EPDM (ethylene propylene diene monomer)	0.006 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
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
<u>Resistance of non-bridged layers, R<sub>NB</sub> =</u>	<u>2.920 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

$$R_{P1} = R_{NB} + R_{L1} = 2.920 + 5.550 = 8.470 \text{ m}^2\text{K/W} \quad F_{P1} = 91.000\%$$

$$R_{P2} = R_{NB} + R_{L2} = 2.920 + 1.538 = 4.459 \text{ m}^2\text{K/W} \quad F_{P2} = 9.000\%$$

### Upper resistance limit

$$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}))$$

$$R_{upper} = 1 / ((0.910/8.470) + (0.090/4.459)) = 7.836 \text{ m}^2\text{K/W}$$

### Lower resistance limit

$$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}))$$

$$R_{lower} = 2.920 + 1 / ((0.910/5.550) + (0.090/1.538)) = 7.416 \text{ m}^2\text{K/W}$$

### Total resistance of roof

$$R_T = (R_{upper} + R_{lower}) / 2 = (7.836 + 7.416) / 2 = 7.63 \text{ m}^2\text{K/W}$$

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) = 0.13 W/m<sup>2</sup>K

Structure element : Flat roof  
 Condensation calculations performed in accordance with BS5250:2011

**Condensation is occurring at the following layers interfaces:-**

Interface 1 : Plywood (500 kg/m<sup>3</sup>) / Beltermo Ultra

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)	Interface 1 Gc (Kg/m <sup>2</sup> )	Ma (Kg/m <sup>2</sup> )
Jan	21.00	56.10	5.90	85.50	0.04619	0.12502
Feb	21.00	55.20	5.70	83.50	0.04075	0.16577
Mar	21.00	55.50	6.90	82.00	0.03723	0.20300
Apr	21.00	56.20	8.80	79.50	0.02329	0.22629
May	21.00	59.30	11.50	79.00	-0.00285	0.22344
Jun	21.00	64.30	14.30	79.50	-0.02010	0.20333
Jul	21.00	68.80	16.10	80.50	-0.03090	0.17244
Aug	21.00	69.30	16.00	81.50	-0.02739	0.14504
Sep	21.00	66.60	14.30	83.00	-0.01162	0.13343
Oct	21.00	63.20	11.90	85.00	0.00718	0.00718
Nov	21.00	58.20	8.50	84.50	0.03104	0.03822
Dec	21.00	57.00	7.00	85.50	0.04061	0.07883

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) = 0.22629 Kg/m<sup>2</sup>

Annual moisture accumulation = 0.13343 Kg/m<sup>2</sup>

**Project Information**

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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 (1.5)	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 (200.0)	60.0	2100.0	0.0
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	30240.0
Gyproc Wallboard	12.5 (12.5)	950.0	850.0	10093750.0
Total				10123990.0
kappa value				10.1240
Limiting condition:	insulation			

Admittance : 1.09 W/m<sup>2</sup>K    Decrement : 0.15 factor    Decrement delay : -14.56 hours

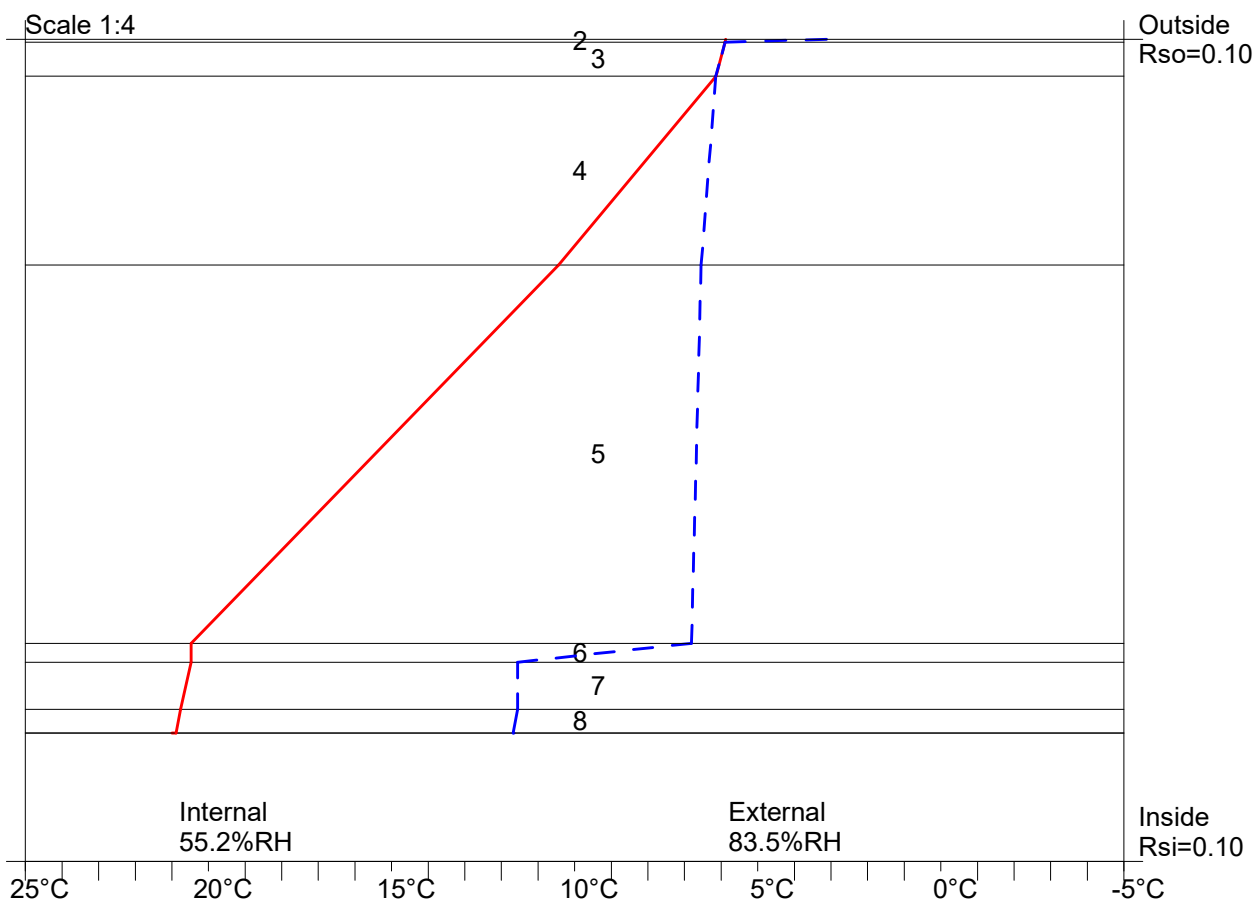
### Condensation Risk Analysis (no account taken of thermal bridges)

#### 3 - Dwellings with low occupancy

Jan	Feb (worst)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21.0C 56.1%	21.0C 55.2%	21.0C 55.5%	21.0C 56.2%	21.0C 59.3%	21.0C 64.3%	21.0C 68.8%	21.0C 69.3%	21.0C 66.6%	21.0C 63.2%	21.0C 58.2%	21.0C 57.0%
5.9C 85.5%	5.7C 83.5%	6.9C 82.0%	8.8C 79.5%	11.5C 79.0%	14.3C 79.5%	16.1C 80.5%	16.0C 81.5%	14.3C 83.0%	11.9C 85.0%	8.5C 84.5%	7.0C 85.5%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m <sup>2</sup> )	Peak Buildup (g/m <sup>2</sup> )	Condensation
1 Outside surface resistance							
2 EPDM (ethylene propylene diene monomer)	5.9	3.1	0.76	0.93			No
3 Plywood (500 kg/m <sup>3</sup> )	5.9	5.9	0.93	0.93			No
4 Beltermo Ultra	6.1	6.1	0.94	0.94	46 in Jan	226 in Apr	Yes
5 SteicoFlex	10.4	6.5	0.97	1.26			No
6 Ampatex Variano	20.5	6.8	0.99	2.41			No
7 Airspace, heat flow upwards, 25 mm thick	20.5	11.6	1.36	2.41			No
8 Gyproc Wallboard	20.8	11.6	1.36	2.45			No
9 Inside surface resistance	20.9	11.7	1.37	2.47			No

Worst case internal / external conditions for graph : 21.0°C @ 55.2%RH / 5.7°C @ 83.5%RH



**Condensation Risk Analysis (no account taken of thermal bridges)**

**3 - Dwellings with low occupancy**

Jan	Feb (worst)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21.0C 56.1%	21.0C 55.2%	21.0C 55.5%	21.0C 56.2%	21.0C 59.3%	21.0C 64.3%	21.0C 68.8%	21.0C 69.3%	21.0C 66.6%	21.0C 63.2%	21.0C 58.2%	21.0C 57.0%
5.9C 85.5%	5.7C 83.5%	6.9C 82.0%	8.8C 79.5%	11.5C 79.0%	14.3C 79.5%	16.1C 80.5%	16.0C 81.5%	14.3C 83.0%	11.9C 85.0%	8.5C 84.5%	7.0C 85.5%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m <sup>2</sup> )	Peak Buildup (g/m <sup>2</sup> )	Condensation
1 Outside surface resistance							
2 EPDM (ethylene propylene diene monomer)	16.2	12.8	1.47	1.84			No
3 Plywood (500 kg/m <sup>3</sup> )	16.2	14.0	1.60	1.84			No
4 Beltermo Ultra	16.2	14.5	1.64	1.85	46 in Jan	226 in Apr	Yes
5 SteicoFlex	17.6	14.5	1.65	2.01			No
6 Ampatex Variano	20.8	14.5	1.65	2.46			No
7 Airspace, heat flow upwards, 25 mm thick	20.8	15.1	1.71	2.46			No
8 Gyproc Wallboard	20.9	15.1	1.71	2.47			No
9 Inside surface resistance	21.0	15.1	1.71	2.48			No

Worst case internal / external conditions for graph : 21.0°C @ 68.8%RH / 16.1°C @ 80.5%RH

