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 (m²K/W)	Pitch (º)	Bridge details Air gaps (Level, Delta U")
Outside surface resistance	-	-	0.100		
Zinc	0.5	111.111	0.000		
Plywood (500 kg/m³)	18.0	0.130	0.000		
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.000		
Ampatex Aero	-	-	-		
Beltermo Ultra	100.0	0.042	2.350		L:0 0.000W/m²K
SteicoFlex	175.0	0.036	4.850		9.000% Softwood (175.0mm) L:0 0.000W/m²K
Ampatex DB90	-	-	-		
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160		
Gyproc Wallboard	12.5	0.189	0.066		
Inside surface resistance	-	-	0.100		
Total thickness	**381.0mm**				

U-value = 0.15W/m²K

U-value, Combined Method : 0.145W/m²K (upper/lower limit 7.084 / 6.705m²K/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/m²K

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

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m²K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
Zinc	0.5	111.111	0.000	-	100000
Plywood (500 kg/m³)	18.0	0.130	0.000	1000.00	18.00
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.000	-	0.00
Ampatex Aero	-	-	-	-	0.20
Beltermo Ultra	100.0	0.042	2.350	15.00	1.50
SteicoFlex	175.0	0.036	4.850	5.00	0.88
Ampatex DB90	-	-	-	-	100.00
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	-	-
Total thickness	**381.0mm**				

Detailed U-value Calculation Results

Construction includes 1 bridged layer

Non-bridged layers

Outside surface resistance	0.100 m²K/W
Beltermo Ultra	2.350 m²K/W
Airspace, heat flow upwards, 25 mm thick	0.160 m²K/W
Gyproc Wallboard	0.066 m²K/W
Inside surface resistance	0.100 m²K/W
Resistance of non-bridged layers, R_{NB} =	2.776 m²K/W

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex
Path 2 - Softwood

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 2.776 + 4.850 = 7.626$ m²K/W $F_{P1} = 91.000\%$
$R_{P2} = R_{NB} + R_{L2} = 2.776 + 1.346 = 4.122$ m²K/W $F_{P2} = 9.000\%$

Upper resistance limit

$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}))$
$R_{upper} = 1 / ((0.910/7.626) + (0.090/4.122)) = 7.084$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}))$
$R_{lower} = 2.776 + 1 / ((0.910/4.850) + (0.090/1.346)) = 6.705$m²K/W

Total resistance of roof

$R_T = (R_{upper} + R_{lower}) / 2 = (7.084 + 6.705) / 2 = 6.89$ m²K/W

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) = 0.15 W/m²K

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

Condensation is occuring at the following layers interfaces:-
Interface 1 : Ampatex Aero / Beltermo Ultra

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)	Interface 1 Gc (Kg/m²)	Ma (Kg/m²)
Jan	21.00	56.10	5.90	85.50	0.01179	0.03522
Feb	21.00	55.20	5.70	83.50	0.01042	0.04564
Mar	21.00	55.50	6.90	82.00	0.00968	0.05532
Apr	21.00	56.20	8.80	79.50	0.00635	0.06168
May	21.00	59.30	11.50	79.00	0.00277	0.06445
Jun	21.00	64.30	14.30	79.50	-0.00102	0.06343
Jul	21.00	68.80	16.10	80.50	-0.00330	0.06013
Aug	21.00	69.30	16.00	81.50	-0.00267	0.05746
Sep	21.00	66.60	14.30	83.00	0.00043	0.00043
Oct	21.00	63.20	11.90	85.00	0.00435	0.00478
Nov	21.00	58.20	8.50	84.50	0.00818	0.01295
Dec	21.00	57.00	7.00	85.50	0.01047	0.02343

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) = 0.06445 Kg/m²

Annual moisture accumulation = 0.05746 Kg/m²

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Thermal Mass Details

	Thickness assessed (actual) (mm)	Density (kg/m³)	Specific heat capacity (J/kgK)	Heat capacity (kJ/m²K)
Zinc	0.0 (0.5)	7200.0	110.0	0.0
Plywood (500 kg/m³)	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
Ampatex Aero	0.0 (-)	300.0	850.0	0.0
Beltermo Ultra	0.0 (100.0)	180.0	2100.0	0.0
SteicoFlex	0.0 (175.0)	60.0	2100.0	0.0
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	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 : 1.08 W/m²K Decrement : 0.18 factor Decrement delay : -13.42 hours

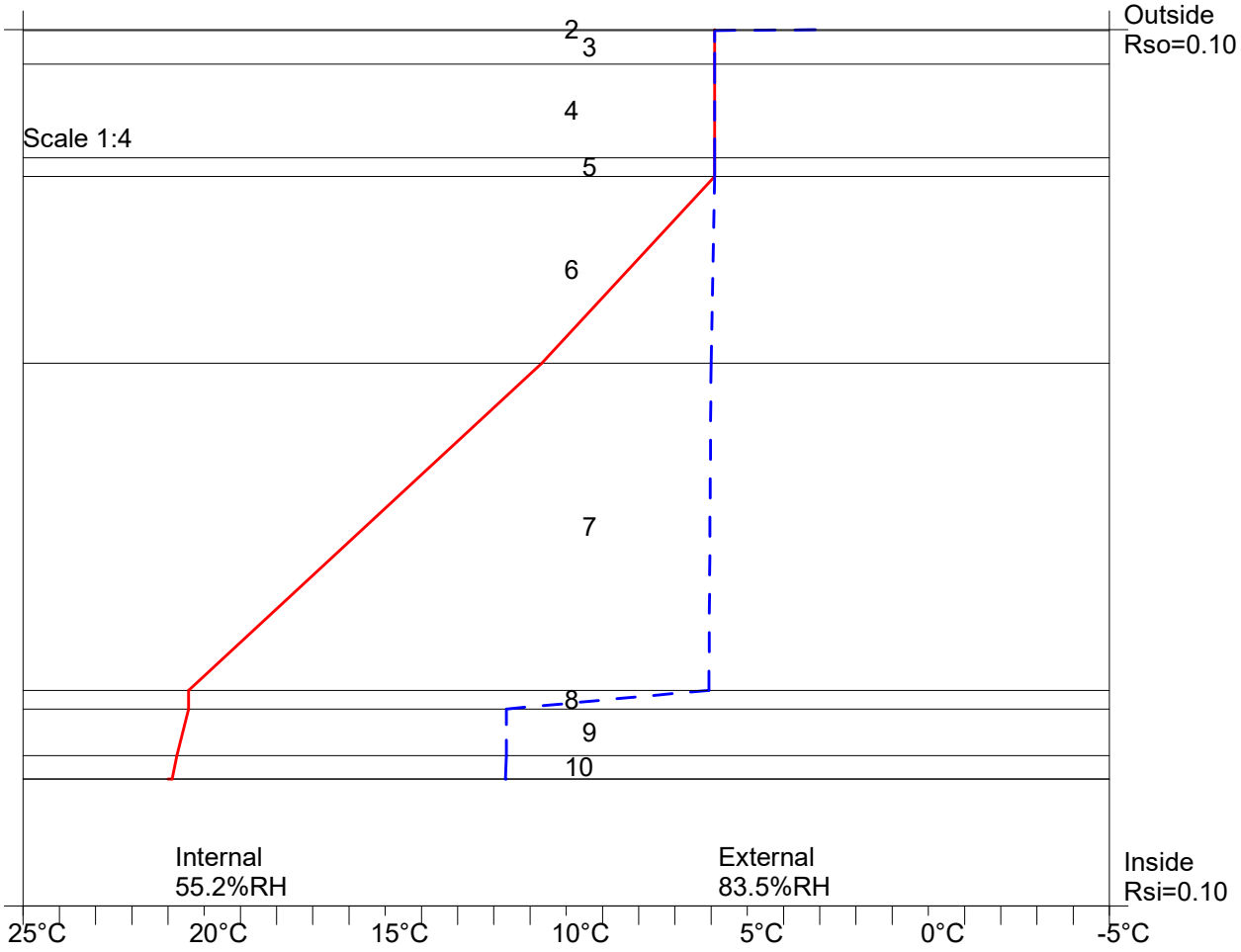
Condensation Risk Analysis (no account taken of thermal bridges)

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. ºC	Dewpoint Temp. ºC	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m²)	Peak Buildup (g/m²)	Conden-sation
1 Outside surface resistance	5.9	3.1	0.76	0.93			No
2 Zinc	5.9	5.9	0.93	0.93		0 in May	No
3 Plywood (500 kg/m³)	5.9	5.9	0.93	0.93			No
4 Airspace, heat flow upwards, 50 mm thick	5.9	5.9	0.93	0.93		0 in May	No
5 Ampatex Aero	5.9	5.9	0.93	0.93	12 in Jan	64 in May	Yes
6 Beltermo Ultra	10.7	6.0	0.93	1.28			No
7 SteicoFlex	20.4	6.1	0.94	2.40			No
8 Ampatex DB90	20.4	11.7	1.37	2.40			No
9 Airspace, heat flow upwards, 25 mm thick	20.8	11.7	1.37	2.45			No
10 Gyproc Wallboard	20.9	11.7	1.37	2.47			No
11 Inside surface resistance							

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. ºC	Dewpoint Temp. ºC	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m²)	Peak Buildup (g/m²)	Conden-sation
1 Outside surface resistance	16.2	12.8	1.47	1.84			No
2 Zinc	16.2	15.1	1.71	1.84		0 in May	No
3 Plywood (500 kg/m³)	16.2	15.1	1.71	1.84			No
4 Airspace, heat flow upwards, 50 mm thick	16.2	15.1	1.71	1.84		0 in May	No
5 Ampatex Aero	16.2	15.1	1.71	1.84	12 in Jan	64 in May	Yes
6 Beltermo Ultra	17.7	15.1	1.71	2.02			No
7 SteicoFlex	20.8	15.1	1.71	2.46			No
8 Ampatex DB90	20.8	15.1	1.71	2.46			No
9 Airspace, heat flow upwards, 25 mm thick	20.9	15.1	1.71	2.47			No
10 Gyproc Wallboard	21.0	15.1	1.71	2.48			No
11 Inside surface resistance							

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