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		
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.006		
Plywood (500 kg/m³)	18.0	0.130	0.138		
Beltermo Ultra	60.0	0.042	1.400		L:0 0.000W/m²K
SteicoFlex	200.0	0.036	5.550		9.000% Softwood (200.0mm) L:0 0.000W/m²K
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		
Total thickness	**317.0mm**				

U-value = 0.15W/m²K

U-value, Combined Method : 0.151W/m²K (upper/lower limit 6.819 / 6.466m²K/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	-	-
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.006	30000.00	45.00
Plywood (500 kg/m³)	18.0	0.130	0.138	1000.00	18.00
Beltermo Ultra	60.0	0.042	1.400	15.00	0.90
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	-	-
Total thickness	**317.0mm**				

Detailed U-value Calculation Results

Construction includes 1 bridged layer

Non-bridged layers

Outside surface resistance	0.100 m²K/W
EPDM (ethylene propylene diene monomer)	0.006 m²K/W
Plywood (500 kg/m³)	0.138 m²K/W
Beltermo Ultra	1.400 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} =	1.970 m²K/W

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex

Path 2 - Softwood

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 1.970 + 5.550 = 7.520$ m²K/W $F_{P1} = 91.000\%$

$R_{P2} = R_{NB} + R_{L2} = 1.970 + 1.538 = 3.509$ m²K/W $F_{P2} = 9.000\%$

Upper resistance limit

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

$R_{upper} = 1 / ((0.910/7.520) + (0.090/3.509)) = 6.819$m²K/W

Lower resistance limit

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

$R_{lower} = 1.970 + 1 / ((0.910/5.550) + (0.090/1.538)) = 6.466$m²K/W

Total resistance of roof

$R_T = (R_{upper} + R_{lower}) / 2 = (6.819 + 6.466) / 2 = 6.64$ 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 : Plywood (500 kg/m³) / 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	0.04671	0.12604
Feb	21.00	55.20	5.70	83.50	0.04119	0.16723
Mar	21.00	55.50	6.90	82.00	0.03752	0.20475
Apr	21.00	56.20	8.80	79.50	0.02327	0.22802
May	21.00	59.30	11.50	79.00	-0.00309	0.22493
Jun	21.00	64.30	14.30	79.50	-0.02064	0.20430
Jul	21.00	68.80	16.10	80.50	-0.03161	0.17269
Aug	21.00	69.30	16.00	81.50	-0.02804	0.14464
Sep	21.00	66.60	14.30	83.00	-0.01199	0.13265
Oct	21.00	63.20	11.90	85.00	0.00713	0.00713
Nov	21.00	58.20	8.50	84.50	0.03121	0.03834
Dec	21.00	57.00	7.00	85.50	0.04099	0.07933

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) = 0.22802 Kg/m²

Annual moisture accumulation = 0.13265 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)
EPDM (ethylene propylene diene monomer)	0.0 (1.5)	1150.0	1000.0	0.0
Plywood (500 kg/m³)	0.0 (18.0)	500.0	1600.0	0.0
Beltermo Ultra	0.0 (60.0)	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/m²K Decrement : 0.29 factor Decrement delay : -11.73 hours

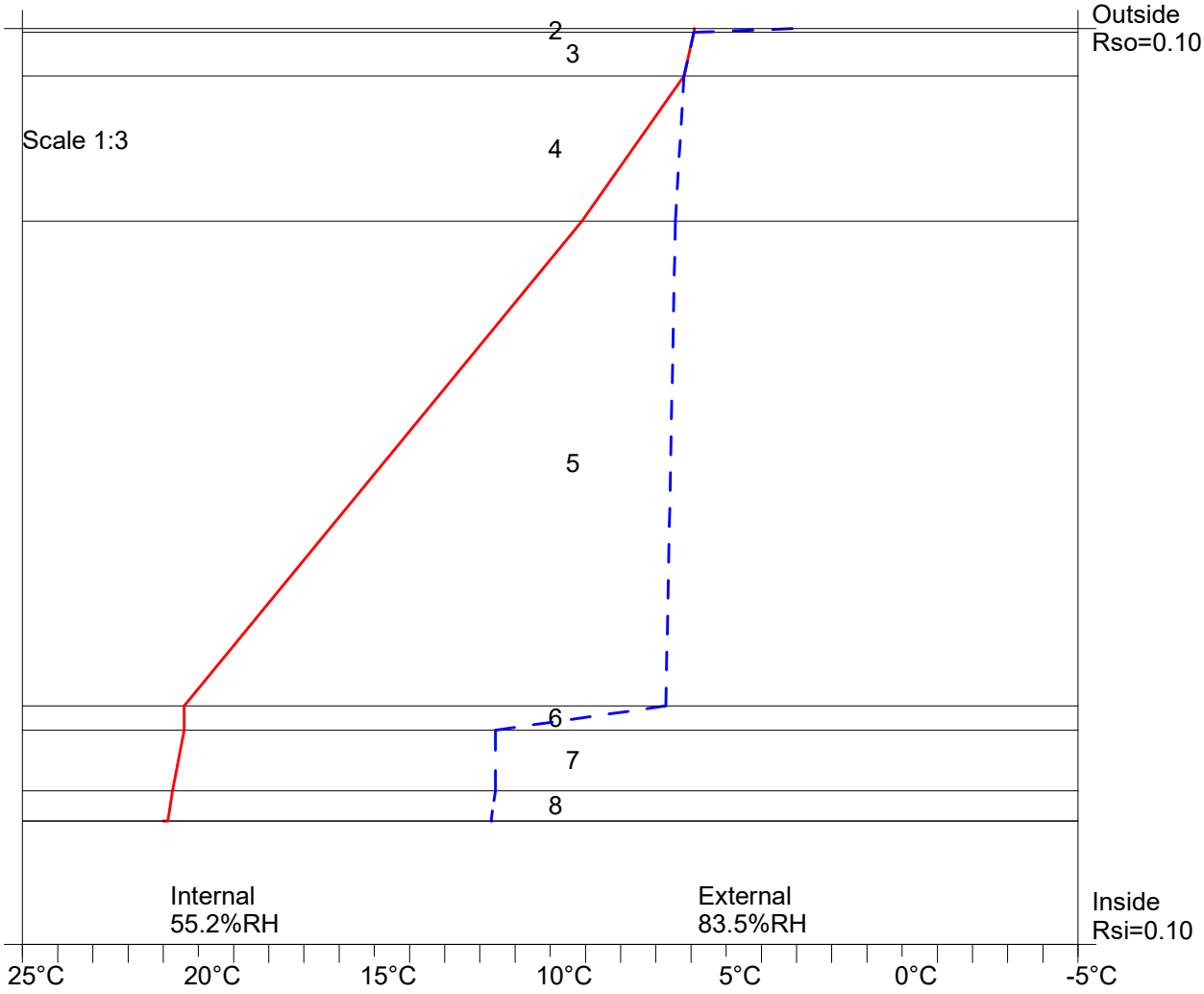
Condensation Risk Analysis (no account taken of thermal bridges)

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 EPDM (ethylene propylene diene monomer)	5.9	5.9	0.93	0.93			No
3 Plywood (500 kg/m³)	6.2	6.2	0.95	0.95	47 in Jan	228 in Apr	Yes
4 Beltermo Ultra	9.1	6.4	0.96	1.16			No
5 SteicoFlex	20.4	6.7	0.98	2.40			No
6 Ampatex Variano	20.4	11.6	1.36	2.40			No
7 Airspace, heat flow upwards, 25 mm thick	20.7	11.6	1.36	2.45			No
8 Gyproc Wallboard	20.9	11.7	1.37	2.47			No
9 Inside surface resistance							

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



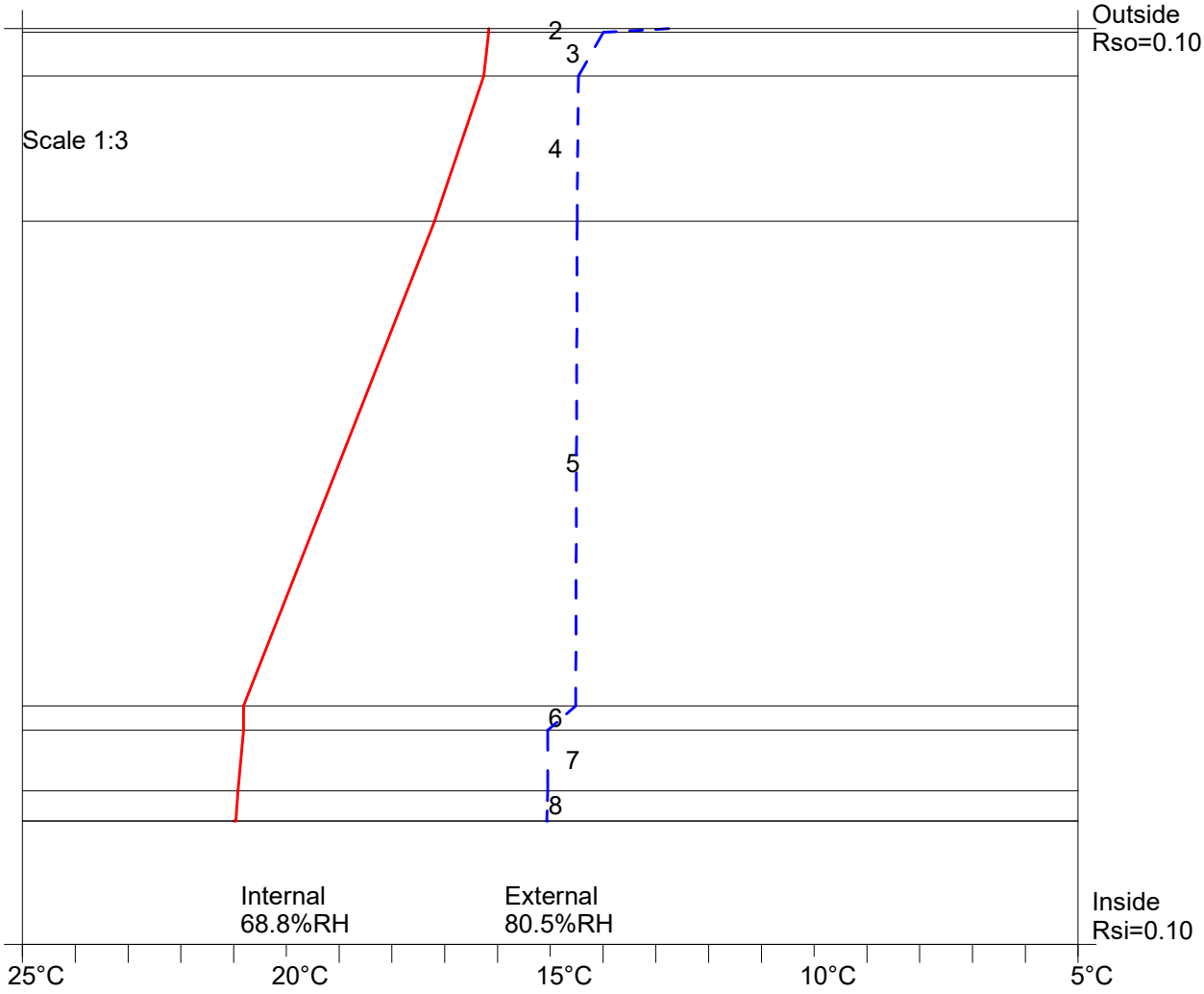
Condensation Risk Analysis (no account taken of thermal bridges)

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 EPDM (ethylene propylene diene monomer)	16.2	14.0	1.60	1.84			No
3 Plywood (500 kg/m³)	16.3	14.5	1.65	1.85	47 in Jan	228 in Apr	Yes
4 Beltermo Ultra	17.2	14.5	1.65	1.96			No
5 SteicoFlex	20.8	14.5	1.65	2.46			No
6 Ampatex Variano	20.8	15.1	1.71	2.46			No
7 Airspace, heat flow upwards, 25 mm thick	20.9	15.1	1.71	2.47			No
8 Gyproc Wallboard	21.0	15.1	1.71	2.48			No
9 Inside surface resistance							

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



Calculations are based on manufacturers information and for default structures.