Back to Earth SW Ltd
7 Tuns Lane
Silverton, Exeter
Devon. EX5 4HY

Project Information
Reference
Date 14 September 2018

Construction Type
Element : Pitched roof, ceiling at rafter line - 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		
Pitched roof, tiles, with underlay or boards	-	-	0.000		
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.000		
Ampatex Aero	-	-	-		
SteicoFlex	100.0	0.036	2.750		9.000% Softwood (100.0mm) L:0 0.000W/m²K
Beltermo Kombi	100.0	0.038	2.600		L:0 0.000W/m²K
Beltermo Ultra	100.0	0.042	2.350		L:0 0.000W/m²K
Ampatex Sinco	-	-	-		
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	**387.5mm**				

U-value = 0.13W/m²K

U-value, Combined Method : 0.129W/m²K (upper/lower limit 7.897 / 7.609m²K/W, dUf 0.0006, 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 : 17.0000W/mK nf : 6.700 per m² Af : 7.450mm² Recess : 0.0mm
Delta Uf for Beltermo Ultra : 0.0006
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 (m²K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
Pitched roof, tiles, with underlay or boards	-	-	0.000	-	0.00
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.000	-	0.00
Ampatex Aero	-	-	-	-	0.20
SteicoFlex	100.0	0.036	2.750	5.00	0.50
Beltermo Kombi	100.0	0.038	2.600	15.00	1.50
Beltermo Ultra	100.0	0.042	2.350	15.00	1.50
Ampatex Sinco	-	-	-	-	25.00
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	**387.5mm**				

Detailed U-value Calculation Results

Construction includes 1 bridged layer

Non-bridged layers

Outside surface resistance	0.100 m²K/W
Beltermo Kombi	2.600 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} =	5.376 m²K/W

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex
Path 2 - Softwood

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 5.376 + 2.750 = 8.126$ m²K/W $F_{P1} = 91.000\%$
$R_{P2} = R_{NB} + R_{L2} = 5.376 + 0.769 = 6.145$ m²K/W $F_{P2} = 9.000\%$

Upper resistance limit

$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}))$
$R_{upper} = 1 / ((0.910/8.126) + (0.090/6.145)) = 7.897$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}))$
$R_{lower} = 5.376 + 1 / ((0.910/2.750) + (0.090/0.769)) = 7.609$m²K/W

Total resistance of roof

$R_T = (R_{upper} + R_{lower}) / 2 = (7.897 + 7.609) / 2 = 7.75$ m²K/W

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Warm pitched roof - insulation over rafters
Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 6.700 per m² Af : 7.450mm² Recess : 0.0mm
Delta Uf for Beltermo Ultra : 0.0006
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) = 0.13 W/m²K

Structure element : Pitched roof, ceiling at rafter line
Condensation calculations performed in accordance with BS5250:2011

Condensation is occuring at the following layers interfaces:-

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)
Jan	21.00	56.10	5.90	85.50
Feb	21.00	55.20	5.70	83.50
Mar	21.00	55.50	6.90	82.00
Apr	21.00	56.20	8.80	79.50
May	21.00	59.30	11.50	79.00
Jun	21.00	64.30	14.30	79.50
Jul	21.00	68.80	16.10	80.50
Aug	21.00	69.30	16.00	81.50
Sep	21.00	66.60	14.30	83.00
Oct	21.00	63.20	11.90	85.00
Nov	21.00	58.20	8.50	84.50
Dec	21.00	57.00	7.00	85.50

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) = 0.00000 Kg/m²

Annual moisture accumulation = 0.00000 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)
Pitched roof, tiles, with underlay or boards	0.0 (-)	1.2	1008.0	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
SteicoFlex	0.0 (100.0)	60.0	2100.0	0.0
Beltermo Kombi	0.0 (100.0)	110.0	2100.0	0.0
Beltermo Ultra	0.0 (100.0)	180.0	2100.0	0.0
Ampatex Sinco	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)	950.0	850.0	10093750.0
Total				10124746.0
kappa value				10.1247

Limiting condition: insulation

Admittance : 1.35 W/m²K Decrement : 0.11 factor Decrement delay : -15.18 hours

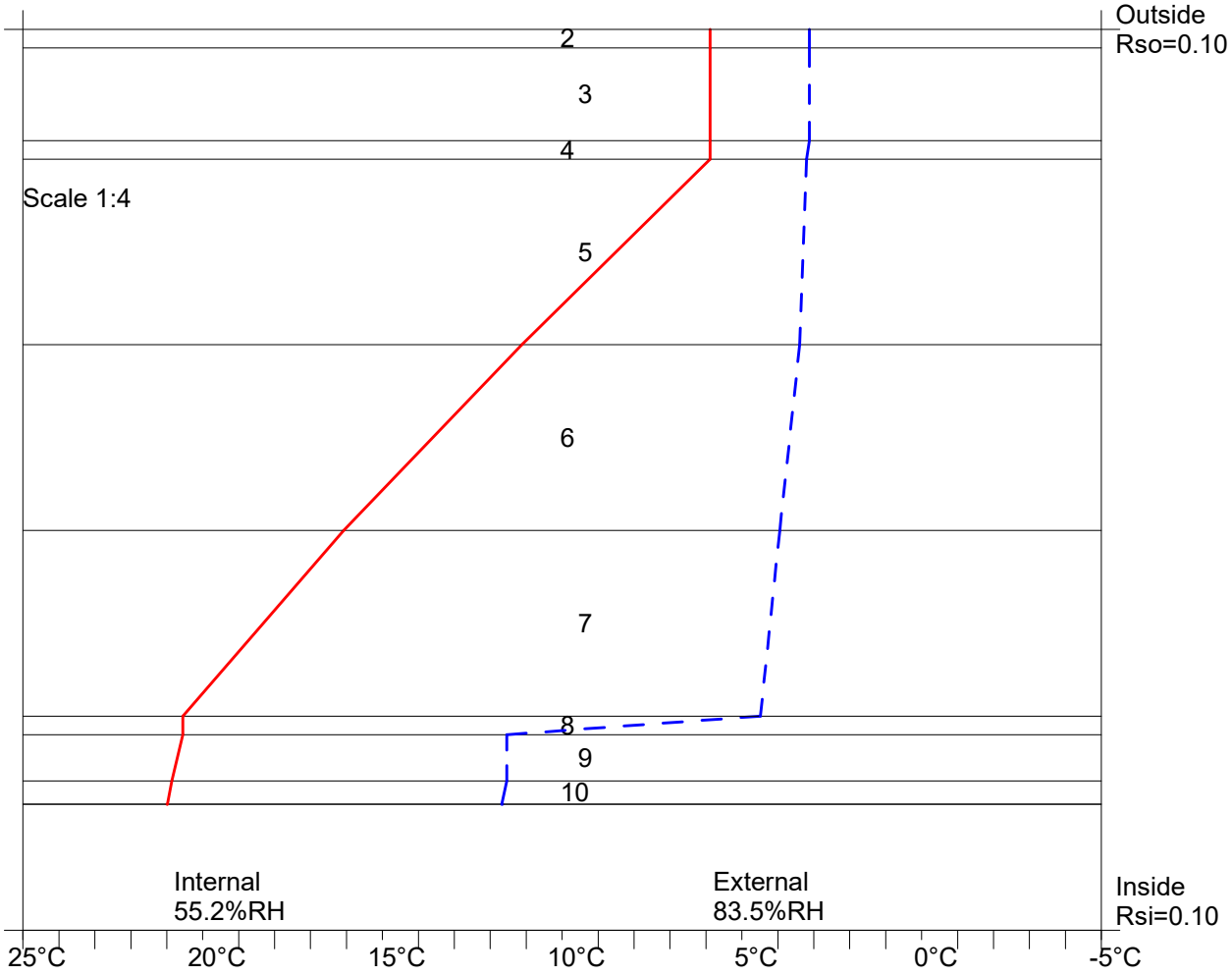
Condensation Risk Analysis (no account taken of thermal bridges)

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 Pitched roof, tiles, with underlay or boards	5.9	3.1	0.76	0.93			No
3 Airspace, heat flow upwards, 50 mm thick	5.9	3.1	0.76	0.93			No
4 Ampatex Aero	5.9	3.2	0.77	0.93			No
5 SteicoFlex	11.1	3.4	0.78	1.32			No
6 Beltermo Kombi	16.1	3.9	0.81	1.83			No
7 Beltermo Ultra	20.6	4.5	0.84	2.42			No
8 Ampatex Sinco	20.6	11.5	1.36	2.42			No
9 Airspace, heat flow upwards, 25 mm thick	20.9	11.5	1.36	2.46			No
10 Gyproc Wallboard	21.0	11.7	1.37	2.48			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 Pitched roof, tiles, with underlay or boards	16.2	12.8	1.47	1.84			No
3 Airspace, heat flow upwards, 50 mm thick	16.2	12.8	1.47	1.84			No
4 Ampatex Aero	16.2	12.8	1.47	1.84			No
5 SteicoFlex	17.8	12.8	1.48	2.04			No
6 Beltermo Kombi	19.4	12.9	1.49	2.25			No
7 Beltermo Ultra	20.9	13.1	1.50	2.46			No
8 Ampatex Sinco	20.9	15.0	1.70	2.46			No
9 Airspace, heat flow upwards, 25 mm thick	21.0	15.0	1.70	2.48			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