

Back to Earth SW Ltd

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Project Information

Reference

Date 14 September 2018

Construction Type

Element : Pitched roof, ceiling at rafter line - 0.0 Specification Generator

Internal surface emissivity : High External surface emissivity : High

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m ² K/W)	Pitch (°)	Bridge details Air gaps (Level, Delta U")
Outside surface resistance	-	-	0.100		
Pitched roof, tiles, underlay and boards	-	-	0.300		
Ampatex Aero	-	-	-		
Beltermo Ultra	120.0	0.042	2.850		L:0 0.000W/m ² K
SteicoFlex	175.0	0.036	4.850		9.000% Softwood (175.0mm) L:0 0.000W/m ² K
Oriented strandboard (OSB)	11.0	0.130	0.085		
Ampatex Sinco	-	-	-		
SteicoFlex	50.0	0.036	1.350		11.800% Softwood (50.0mm) L:0 0.000W/m ² K
Gyproc Wallboard	12.5	0.190	0.066		
Inside surface resistance	-	-	0.100		
Total thickness	368.5mm				

U-value = 0.11W/m²K

U-value, Combined Method : 0.114W/m²K (upper/lower limit 9.102 / 8.472m²K/W, dUf 0.0021, 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 m² Af : 12.500mm² Recess : 5.0mm

Delta Uf for Beltermo Ultra : 0.0021

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 (m ² K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
Pitched roof, tiles, underlay and boards	-	-	0.300	-	0.00
Ampatex Aero	-	-	-	-	0.20
Beltermo Ultra	120.0	0.042	2.850	15.00	1.80
SteicoFlex	175.0	0.036	4.850	5.00	0.88
Oriented strandboard (OSB)	11.0	0.130	0.085	250.00	2.75
Ampatex Sinco	-	-	-	-	25.00
SteicoFlex	50.0	0.036	1.350	5.00	0.25
Gyproc Wallboard	12.5	0.190	0.066	50.00	0.63
Inside surface resistance	-	-	0.100	-	-
Total thickness	368.5mm				

Detailed U-value Calculation Results

Construction includes 2 bridged layers

Non-bridged layers

Outside surface resistance	0.100 m ² K/W
Pitched roof, tiles, underlay and boards	0.300 m ² K/W
Beltermo Ultra	2.850 m ² K/W
Oriented strandboard (OSB)	0.085 m ² K/W
Gyproc Wallboard	0.066 m ² K/W
Inside surface resistance	0.100 m ² K/W
<u>Resistance of non-bridged layers, R_{NB} =</u>	<u>3.501 m²K/W</u>

Bridged layers

SteicoFlex (L1) bridged by Softwood (B1)
SteicoFlex (L2) bridged by Softwood (B2)

Path 1 - SteicoFlex
Path 2 - Softwood /
Path 3 - SteicoFlex
Path 4 - Softwood /

Resistance and fraction of heat flow paths

$$\begin{aligned}R_{P1} &= R_{NB} + R_{L1} = 3.501 + 6.200 = 9.701 \text{ m}^2\text{K/W} & F_{P1} &= 80.262\% \\R_{P2} &= R_{NB} + R_{L2} = 3.501 + 2.696 = 6.197 \text{ m}^2\text{K/W} & F_{P2} &= 7.938\% \\R_{P3} &= R_{NB} + R_{L3} = 3.501 + 5.235 = 8.735 \text{ m}^2\text{K/W} & F_{P3} &= 10.738\% \\R_{P4} &= R_{NB} + R_{L4} = 3.501 + 1.731 = 5.231 \text{ m}^2\text{K/W} & F_{P4} &= 1.062\%\end{aligned}$$

Upper resistance limit

$$R_{\text{upper}} = 1 / \left(\frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} + \frac{F_{P3}}{R_{P3}} + \frac{F_{P4}}{R_{P4}} \right)$$
$$R_{\text{upper}} = 1 / \left(\frac{0.803}{9.701} + \frac{0.079}{6.197} + \frac{0.107}{8.735} + \frac{0.011}{5.231} \right) = 9.102 \text{ m}^2\text{K/W}$$

Lower resistance limit

$$R_{\text{lower}} = R_{NB} + 1 / \left(\frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right) + 1 / \left(\frac{F_{L2}}{R_{L2}} + \frac{F_{B2}}{R_{B2}} \right)$$
$$R_{\text{lower}} = 3.501 + 1 / \left(\frac{0.910}{4.850} + \frac{0.090}{1.346} \right) + 1 / \left(\frac{0.882}{1.350} + \frac{0.118}{0.385} \right) = 8.472 \text{ m}^2\text{K/W}$$

Total resistance of roof

$$R_T = (R_{\text{upper}} + R_{\text{lower}}) / 2 = (9.102 + 8.472) / 2 = 8.79 \text{ m}^2\text{K/W}$$

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 m² Af : 12.500mm² Recess : 5.0mm

Delta Uf for Beltermo Ultra : 0.0021

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) = 0.11 W/m²K

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

Condensation is occurring at the following layers interfaces:-

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)
Jan	21.00	55.40	4.40	86.50
Feb	21.00	54.40	4.20	84.00
Mar	21.00	54.60	5.90	81.50
Apr	21.00	55.00	8.00	78.50
May	21.00	58.20	11.10	78.00
Jun	21.00	62.90	14.10	78.00
Jul	21.00	67.10	16.00	78.50
Aug	21.00	67.60	15.90	79.50
Sep	21.00	65.60	14.00	82.50
Oct	21.00	61.60	11.10	84.50
Nov	21.00	57.10	7.30	85.00
Dec	21.00	56.30	5.40	87.00

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/m ³)	Specific heat capacity (J/kgK)	Heat capacity (kJ/m ² K)
Pitched roof, tiles, underlay and boards	0.0 (-)	1.2	1008.0	0.0
Ampatex Aero	0.0 (-)	300.0	850.0	0.0
Beltermo Ultra	0.0 (120.0)	180.0	2100.0	0.0
SteicoFlex	0.0 (175.0)	60.0	2100.0	0.0
Oriented strandboard (OSB)	0.0 (11.0)	650.0	1700.0	0.0
Ampatex Sinco	0.0 (-)	280.0	850.0	0.0
SteicoFlex	0.0 (50.0)	60.0	2100.0	0.0
Gyproc Wallboard	12.5 (12.5)	0.0	0.0	0.0

Total 0.0

kappa value 0.0000

Limiting condition: insulation

Admittance : 0.68 W/m²K Decrement : 0.06 factor Decrement delay : -17.83 hours

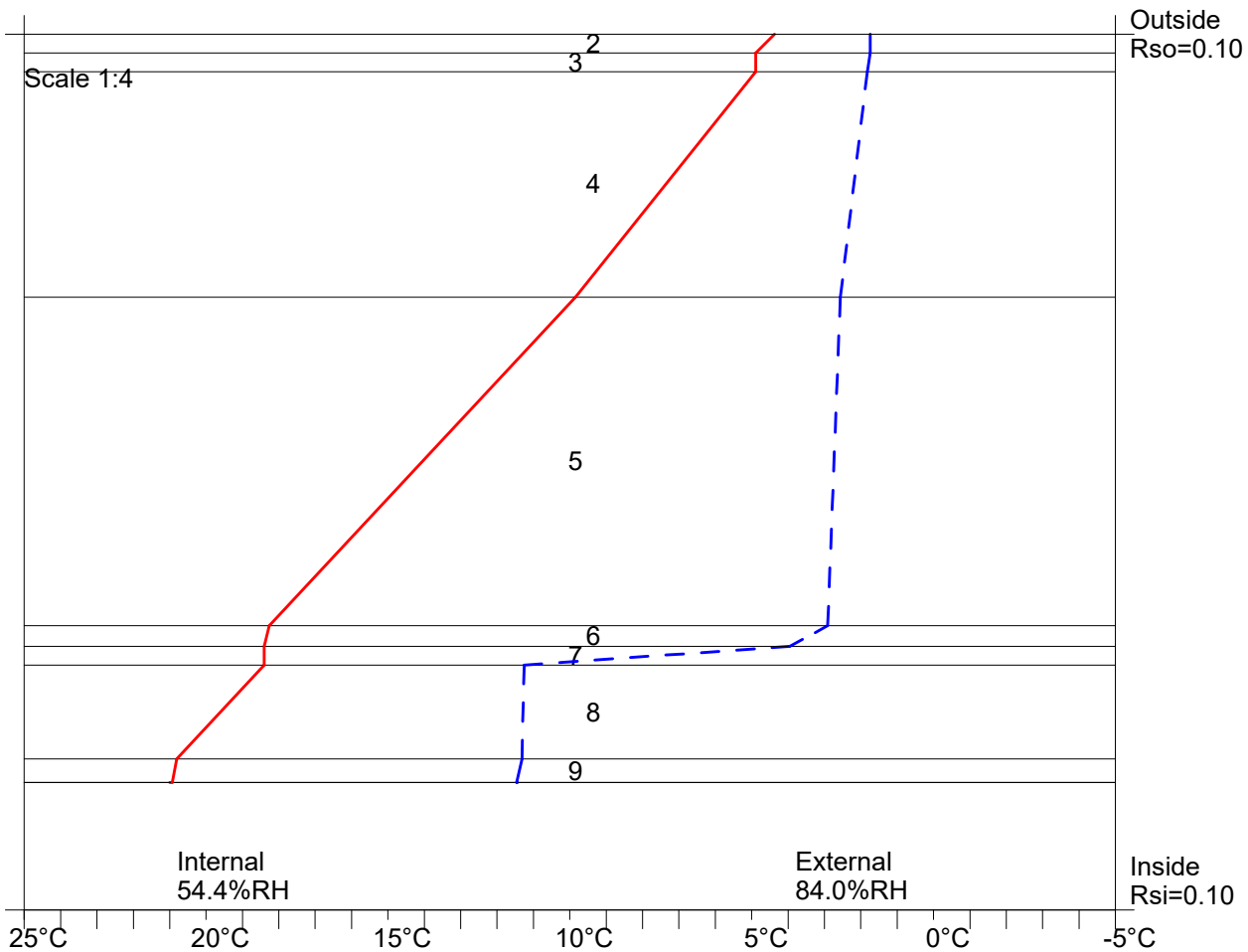
Condensation Risk Analysis (no account taken of thermal bridges)

3 - Dwellings with low occupancy

Jan	Feb (worst)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21.0C 55.4%	21.0C 54.4%	21.0C 54.6%	21.0C 55.0%	21.0C 58.2%	21.0C 62.9%	21.0C 67.1%	21.0C 67.6%	21.0C 65.6%	21.0C 61.6%	21.0C 57.1%	21.0C 56.3%
4.4C 86.5%	4.2C 84.0%	5.9C 81.5%	8.0C 78.5%	11.1C 78.0%	14.1C 78.0%	16.0C 78.5%	15.9C 79.5%	14.0C 82.5%	11.1C 84.5%	7.3C 85.0%	5.4C 87.0%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m ²)	Peak Buildup (g/m ²)	Condensation
1 Outside surface resistance							
2 Pitched roof, tiles, underlay and boards	4.4	1.7	0.69	0.83			No
3 Ampatex Aero	4.9	1.7	0.69	0.87			No
4 Beltermo Ultra	4.9	1.8	0.70	0.87			No
5 SteicoFlex	9.8	2.6	0.73	1.21			No
6 Oriented strandboard (OSB)	18.3	2.9	0.75	2.10			No
7 Ampatex Sinco	18.4	4.0	0.81	2.12			No
8 SteicoFlex	18.4	11.3	1.33	2.12			No
9 Gyproc Wallboard	20.8	11.3	1.34	2.46			No
10 Inside surface resistance	20.9	11.5	1.35	2.47			No

Worst case internal / external conditions for graph : 21.0°C @ 54.4%RH / 4.2°C @ 84.0%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 55.4%	21.0C 54.4%	21.0C 54.6%	21.0C 55.0%	21.0C 58.2%	21.0C 62.9%	21.0C 67.1%	21.0C 67.6%	21.0C 65.6%	21.0C 61.6%	21.0C 57.1%	21.0C 56.3%
4.4C 86.5%	4.2C 84.0%	5.9C 81.5%	8.0C 78.5%	11.1C 78.0%	14.1C 78.0%	16.0C 78.5%	15.9C 79.5%	14.0C 82.5%	11.1C 84.5%	7.3C 85.0%	5.4C 87.0%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m ²)	Peak Buildup (g/m ²)	Condensation
1 Outside surface resistance							
2 Pitched roof, tiles, underlay and boards	16.1	12.3	1.43	1.82			No
3 Ampatex Aero	16.2	12.3	1.43	1.84			No
4 Beltermo Ultra	16.2	12.3	1.43	1.84			No
5 SteicoFlex	17.7	12.4	1.44	2.02			No
6 Oriented strandboard (OSB)	20.2	12.5	1.45	2.36			No
7 Ampatex Sinco	20.2	12.7	1.47	2.37			No
8 SteicoFlex	20.2	14.6	1.66	2.37			No
9 Gyproc Wallboard	20.9	14.6	1.66	2.48			No
10 Inside surface resistance	21.0	14.7	1.67	2.48			No

Worst case internal / external conditions for graph : 21.0°C @ 67.1%RH / 16.0°C @ 78.5%RH

