

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 ² K/W)	Pitch (°)	Bridge details Air gaps (Level, Delta U")
Outside surface resistance	-	-	0.100		
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.000		
Plywood (500 kg/m ³)	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/m ² K
Beltermo Kombi	50.0	0.038	1.300		L:0 0.000W/m ² K
SteicoFlex	150.0	0.036	4.150		9.000% Softwood (150.0mm) L:0 0.000W/m ² 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		

Total thickness 407.0mm

U-value = 0.13W/m²K

U-value, Combined Method : 0.131W/m²K (upper/lower limit 7.823 / 7.440m²K/W, dUf 0.0016, dUg 0.0000, dUp0.0000, dUr0.0000, dUrc1 0.0000, dUrc2 0.0000)

Correction factors

Mechanical fasteners :-

Conventional warm flat roof - roof membrane secured with mechanical fasteners

Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 5.000 per m² Af : 18.100mm² Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0010

Conventional warm flat roof - roof membrane secured with mechanical fasteners

Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 5.000 per m² Af : 18.100mm² Recess : 0.0mm

Delta Uf for Beltermo Kombi : 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 (m ² K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.100	-	-
EPDM (ethylene propylene diene monomer)	1.5	0.250	0.000	30000.00	45.00
Plywood (500 kg/m ³)	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
Beltermo Kombi	50.0	0.038	1.300	15.00	0.75
SteicoFlex	150.0	0.036	4.150	5.00	0.75
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	407.0mm				

Detailed U-value Calculation Results

Construction includes 1 bridged layer

Non-bridged layers

Outside surface resistance	0.100 m ² K/W
Beltermo Ultra	2.350 m ² K/W
Beltermo Kombi	1.300 m ² K/W
Airspace, heat flow upwards, 25 mm thick	0.160 m ² K/W
Gyproc Wallboard	0.066 m ² K/W
Inside surface resistance	0.100 m ² K/W
Resistance of non-bridged layers, R _{NB} =	4.076 m ² K/W

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex

Path 2 - Softwood

Resistance and fraction of heat flow paths

$$R_{P1} = R_{NB} + R_{L1} = 4.076 + 4.150 = 8.226 \text{ m}^2\text{K/W} \quad F_{P1} = 91.000\%$$

$$R_{P2} = R_{NB} + R_{L2} = 4.076 + 1.154 = 5.230 \text{ m}^2\text{K/W} \quad F_{P2} = 9.000\%$$

Upper resistance limit

$$R_{\text{upper}} = 1 / \left(\frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} \right)$$
$$R_{\text{upper}} = 1 / \left(\frac{0.910}{8.226} + \frac{0.090}{5.230} \right) = 7.823 \text{ m}^2\text{K/W}$$

Lower resistance limit

$$R_{\text{lower}} = R_{NB} + 1 / \left(\frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right)$$
$$R_{\text{lower}} = 4.076 + 1 / \left(\frac{0.910}{4.150} + \frac{0.090}{1.154} \right) = 7.440 \text{ m}^2\text{K/W}$$

Total resistance of roof

$$R_T = (R_{\text{upper}} + R_{\text{lower}}) / 2 = (7.823 + 7.440) / 2 = 7.63 \text{ m}^2\text{K/W}$$

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Conventional warm flat roof - roof membrane secured with mechanical fasteners

Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 5.000 per m² Af : 18.100mm² Recess : 0.0mm

Delta Uf for Beltermo Ultra : 0.0010

Conventional warm flat roof - roof membrane secured with mechanical fasteners

Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 5.000 per m² Af : 18.100mm² Recess : 0.0mm

Delta Uf for Beltermo Kombi : 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 : Flat roof
 Condensation calculations performed in accordance with BS5250:2011

Condensation is occurring at the following layers interfaces:-

Interface 1 : Ampatex Aero / Beltermo Ultra

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)	Interface 1 Gc (Kg/m ²)	Ma (Kg/m ²)
Jan	21.00	56.10	5.90	85.50	0.04941	0.14588
Feb	21.00	55.20	5.70	83.50	0.04369	0.18957
Mar	21.00	55.50	6.90	82.00	0.04059	0.23015
Apr	21.00	56.20	8.80	79.50	0.02667	0.25683
May	21.00	59.30	11.50	79.00	-0.00084	0.25598
Jun	21.00	64.30	14.30	79.50	-0.01820	0.23778
Jul	21.00	68.80	16.10	80.50	-0.02909	0.20869
Aug	21.00	69.30	16.00	81.50	-0.02562	0.18307
Sep	21.00	66.60	14.30	83.00	-0.00985	0.17322
Oct	21.00	63.20	11.90	85.00	0.01828	0.01828
Nov	21.00	58.20	8.50	84.50	0.03429	0.05257
Dec	21.00	57.00	7.00	85.50	0.04390	0.09647

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) = 0.25683 Kg/m²

Annual moisture accumulation = 0.17322 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)
EPDM (ethylene propylene diene monomer)	0.0 (1.5)	1150.0	1000.0	0.0
Plywood (500 kg/m ³)	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
Beltermo Kombi	0.0 (50.0)	110.0	2100.0	0.0
SteicoFlex	0.0 (150.0)	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 : 1.08 W/m²K Decrement : 0.13 factor Decrement delay : -15.22 hours

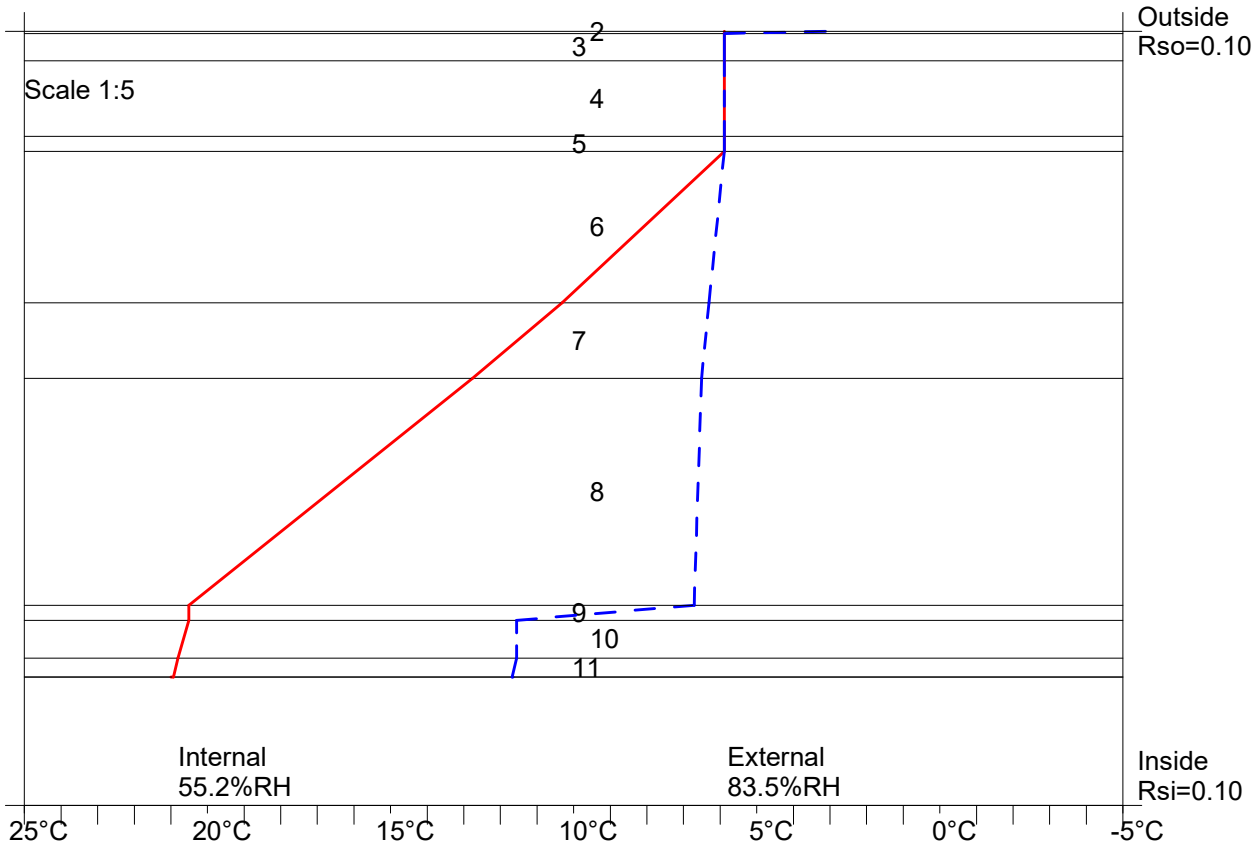
Condensation Risk Analysis (no account taken of thermal bridges)

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 ²)	Peak Buildup (g/m ²)	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 ³)	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 Apr	No
5 Ampatex Aero	5.9	5.9	0.93	0.93			No
6 Beltermo Ultra	5.9	5.9	0.93	0.93	49 in Jan	257 in Apr	Yes
7 Beltermo Kombi	10.3	6.3	0.95	1.25			No
8 SteicoFlex	12.8	6.5	0.97	1.47			No
9 Ampatex Variano	20.5	6.7	0.98	2.41			No
10 Airspace, heat flow upwards, 25 mm thick	20.5	11.6	1.36	2.41			No
11 Gyproc Wallboard	20.8	11.6	1.36	2.46			No
12 Inside surface resistance	20.9	11.7	1.37	2.48			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 ²)	Peak Buildup (g/m ²)	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 ³)	16.2	14.0	1.59	1.84			No
4 Airspace, heat flow upwards, 50 mm thick	16.2	14.4	1.64	1.84		0 in Apr	No
5 Ampatex Aero	16.2	14.4	1.64	1.84			No
6 Beltermo Ultra	16.2	14.4	1.64	1.84	49 in Jan	257 in Apr	Yes
7 Beltermo Kombi	17.6	14.5	1.65	2.01			No
8 SteicoFlex	18.4	14.5	1.65	2.11			No
9 Ampatex Variano	20.8	14.5	1.65	2.46			No
10 Airspace, heat flow upwards, 25 mm thick	20.8	15.1	1.71	2.46			No
11 Gyproc Wallboard	20.9	15.1	1.71	2.48			No
12 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

