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

Project Information
Reference
Date 20 November 2023

Construction Type
Element : Flat roof - Roof-flat-vented-150mm
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)	1.0	0.250	0.004		
Plywood (500 kg/m³)	18.0	0.130	0.138		
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.160		
Ampatop Protecta	-	-	-		
Beltermo Ultra	60.0	0.042	1.400		L:0 0.000W/m²K
SteicoFlex	150.0	0.036	4.150		9.000% Softwood (150.0mm) L:0 0.000W/m²K
Fermacell	10.0	0.320	0.031		
Ampatex DB90	-	-	-		
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160		
Gyproc Wallboard	12.5	0.190	0.066		
Inside surface resistance	-	-	0.100		
Total thickness	**326.5mm**				

U-value = 0.18W/m²K

U-value, Combined Method : 0.176W/m²K (upper/lower limit 5.835 / 5.523m²K/W, dUf 0.0027, 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 : 0.0mm
Delta Uf for Beltermo Ultra : 0.0027
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	-	-
EPDM (ethylene propylene diene monomer)	1.0	0.250	0.004	30000.00	30.00
Plywood (500 kg/m³)	18.0	0.130	0.138	1000.00	18.00
Airspace, heat flow upwards, 50 mm thick	50.0	-	0.160	-	0.00
Ampatop Protecta	-	-	-	-	0.50
Beltermo Ultra	60.0	0.042	1.400	15.00	0.90
SteicoFlex	150.0	0.036	4.150	5.00	0.75
Fermacell	10.0	0.320	0.031	65.00	0.65
Ampatex DB90	-	-	-	-	100.00
Airspace, heat flow upwards, 25 mm thick	25.0	-	0.160	-	0.00
Gyproc Wallboard	12.5	0.190	0.066	50.00	0.63
Inside surface resistance	-	-	0.100	-	-
Total thickness	**326.5mm**				

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)	0.004 m²K/W
Plywood (500 kg/m³)	0.138 m²K/W
Airspace, heat flow upwards, 50 mm thick	0.160 m²K/W
Beltermo Ultra	1.400 m²K/W
Fermacell	0.031 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} =	2.159 m²K/W

Bridged layer

SteicoFlex (L1) bridged by Softwood (B1)

Path 1 - SteicoFlex
Path 2 - Softwood

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 2.159 + 4.150 = 6.309$ m²K/W $F_{P1} = 91.000\%$
$R_{P2} = R_{NB} + R_{L2} = 2.159 + 1.154 = 3.313$ m²K/W $F_{P2} = 9.000\%$

Upper resistance limit

$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}))$
$R_{upper} = 1 / ((0.910/6.309) + (0.090/3.313)) = 5.835$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}))$
$R_{lower} = 2.159 + 1 / ((0.910/4.150) + (0.090/1.154)) = 5.523$m²K/W

Total resistance of roof

$R_T = (R_{upper} + R_{lower}) / 2 = (5.835 + 5.523) / 2 = 5.68$ m²K/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 : 0.0mm
Delta Uf for Beltermo Ultra : 0.0027
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) = 0.18 W/m²K

Structure element : Flat roof
Condensation calculations performed in accordance with BS5250:2021

Condensation is occuring at the following layers interfaces:-

Month	Int (C°)	Int (%RH)	Ext (C°)	Ext (%RH)
Jan	20.00	47.90	3.10	85.00
Feb	20.00	47.40	3.10	83.50
Mar	20.00	48.30	5.20	79.50
Apr	20.00	49.70	7.60	75.50
May	20.00	54.70	10.60	76.00
Jun	20.00	60.90	14.00	74.50
Jul	20.00	65.80	15.80	75.00
Aug	20.00	66.60	15.40	77.50
Sep	20.00	62.30	13.20	79.50
Oct	20.00	57.30	10.00	83.00
Nov	20.00	51.10	6.00	84.00
Dec	20.00	49.30	4.20	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)
EPDM (ethylene propylene diene monomer)	0.0 (1.0)	1150.0	1000.0	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
Ampatop Protecta	0.0 (-)	300.0	850.0	0.0
Beltermo Ultra	0.0 (60.0)	180.0	2100.0	0.0
SteicoFlex	0.0 (150.0)	60.0	2100.0	0.0
Fermacell	10.0 (10.0)	1150.0	1000.0	11500000.0
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	30996.0
Gyproc Wallboard	12.5 (12.5)	0.0	0.0	0.0
Total				11530996.0
kappa value				11.5310
Limiting condition:	insulation			

Admittance : 1.12 W/m²K Decrement : 0.37 factor Decrement delay : -10.24 hours

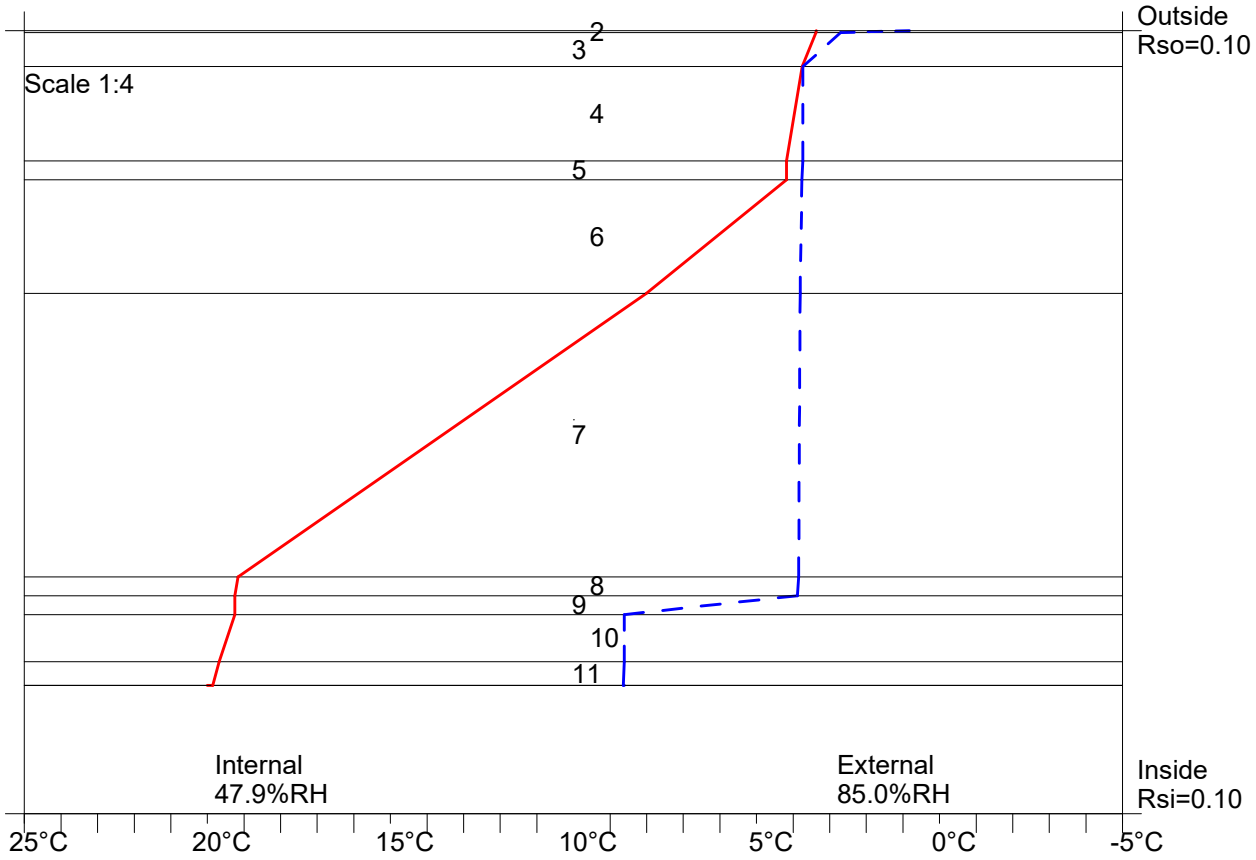
Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, shops and dwellings with low occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 47.9%	20.0C 47.4%	20.0C 48.3%	20.0C 49.7%	20.0C 54.7%	20.0C 60.9%	20.0C 65.8%	20.0C 66.6%	20.0C 62.3%	20.0C 57.3%	20.0C 51.1%	20.0C 49.3%
3.1C 85.0%	3.1C 83.5%	5.2C 79.5%	7.6C 75.5%	10.6C 76.0%	14.0C 74.5%	15.8C 75.0%	15.4C 77.5%	13.2C 79.5%	10.0C 83.0%	6.0C 84.0%	4.2C 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	3.4	0.8	0.65	0.78			No
2 EPDM (ethylene propylene diene monomer)	3.4	2.7	0.74	0.78			No
3 Plywood (500 kg/m³)	3.7	3.7	0.80	0.80		0 in Jan	No
4 Airspace, heat flow upwards, 50 mm thick	4.2	3.7	0.80	0.82			No
5 Ampatop Protecta	4.2	3.8	0.80	0.82		0 in Jan	No
6 Beltermo Ultra	8.0	3.8	0.80	1.07			No
7 SteicoFlex	19.2	3.8	0.80	2.22			No
8 Fermacell	19.3	3.9	0.81	2.23			No
9 Ampatex DB90	19.3	8.6	1.12	2.23			No
10 Airspace, heat flow upwards, 25 mm thick	19.7	8.6	1.12	2.29			No
11 Gyproc Wallboard	19.9	8.6	1.12	2.32			No
12 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 47.9%RH / 3.1°C @ 85.0%RH



Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, shops and dwellings with low occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 47.9%	20.0C 47.4%	20.0C 48.3%	20.0C 49.7%	20.0C 54.7%	20.0C 60.9%	20.0C 65.8%	20.0C 66.6%	20.0C 62.3%	20.0C 57.3%	20.0C 51.1%	20.0C 49.3%
3.1C 85.0%	3.1C 83.5%	5.2C 79.5%	7.6C 75.5%	10.6C 76.0%	14.0C 74.5%	15.8C 75.0%	15.4C 77.5%	13.2C 79.5%	10.0C 83.0%	6.0C 84.0%	4.2C 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	15.9	11.4	1.35	1.80			No
2 EPDM (ethylene propylene diene monomer)	15.9	11.8	1.38	1.80			No
3 Plywood (500 kg/m³)	16.0	12.1	1.41	1.81		0 in Jan	No
4 Airspace, heat flow upwards, 50 mm thick	16.1	12.1	1.41	1.83			No
5 Ampatop Protecta	16.1	12.1	1.41	1.83		0 in Jan	No
6 Beltermo Ultra	17.0	12.1	1.41	1.94			No
7 SteicoFlex	19.8	12.1	1.41	2.31			No
8 Fermacell	19.8	12.1	1.41	2.31			No
9 Ampatex DB90	19.8	13.4	1.54	2.31			No
10 Airspace, heat flow upwards, 25 mm thick	19.9	13.4	1.54	2.33			No
11 Gyproc Wallboard	20.0	13.4	1.54	2.33			No
12 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 65.8%RH / 15.8°C @ 75.0%RH