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Project Information
Reference
Date 14 September 2018

Construction Type
Element :
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	-	-	0.130		
Airspace, heat flow horizontal, 50 mm thick	50.0	-	0.000		
Beltermo Ultra	80.0	0.042	1.900		L:0 0.000W/m²K
Beltermo Kombi	80.0	0.038	2.100		L:0 0.000W/m²K
SteicoFlex	150.0	0.036	4.150		12.500% Prefabricated panels (150.0mm) L:0 0.000W/m²K
Ampatex Sinco	-	-	-		
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180		
Oriented strandboard (OSB)	11.0	0.130	0.085		
Gyproc Wallboard	12.5	0.190	0.066		
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180		11.800% Softwood (25.0mm)
Inside surface resistance	-	-	0.130		
Total thickness	**433.5mm**				

U-value = 0.13W/m²K

U-value, Combined Method : 0.132W/m²K (upper/lower limit 8.415 / 7.989m²K/W, dUf 0.0096, 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 : 28.500mm² Recess : 0.0mm
Delta Uf for Beltermo Ultra : 0.0043
Warm pitched roof - insulation over rafters
Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 6.700 per m² Af : 28.500mm² Recess : 0.0mm
Delta Uf for Beltermo Kombi : 0.0053
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	-	-	0.130	-	-
Airspace, heat flow horizontal, 50 mm thick	50.0	-	0.000	-	0.00
Beltermo Ultra	80.0	0.042	1.900	15.00	1.20
Beltermo Kombi	80.0	0.038	2.100	15.00	1.20
SteicoFlex	150.0	0.036	4.150	5.00	0.75
Ampatex Sinco	-	-	-	-	25.00
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180	-	0.00
Oriented strandboard (OSB)	11.0	0.130	0.085	250.00	2.75
Gyproc Wallboard	12.5	0.190	0.066	50.00	0.63
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180	-	0.00
Inside surface resistance	-	-	0.130	-	-
Total thickness	**433.5mm**				

Detailed U-value Calculation Results

Construction includes 2 bridged layers

Non-bridged layers

Outside surface resistance	0.130 m²K/W
Beltermo Ultra	1.900 m²K/W
Beltermo Kombi	2.100 m²K/W
Airspace, heat flow horizontal, 25 mm thick	0.180 m²K/W
Oriented strandboard (OSB)	0.085 m²K/W
Gyproc Wallboard	0.066 m²K/W
Inside surface resistance	0.130 m²K/W
Resistance of non-bridged layers, R_{NB} =	4.591 m²K/W

Bridged layers

SteicoFlex (L1) bridged by Prefabricated panels (B1)
Airspace, heat flow horizontal, 25 mm thick (L2) bridged by Softwood (B2)

Path 1 - SteicoFlex
Path 2 - Prefabrica
Path 3 - SteicoFlex
Path 4 - Prefabrica

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 4.591 + 4.330 = 8.921$ m²K/W $F_{P1} = 77.175\%$
$R_{P2} = R_{NB} + R_{L2} = 4.591 + 1.430 = 6.021$ m²K/W $F_{P2} = 11.025\%$
$R_{P3} = R_{NB} + R_{L3} = 4.591 + 4.342 = 8.933$ m²K/W $F_{P3} = 10.325\%$
$R_{P4} = R_{NB} + R_{L4} = 4.591 + 1.442 = 6.033$ m²K/W $F_{P4} = 1.475\%$

Upper resistance limit

$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}) + (F_{P3}/R_{P3}) + (F_{P4}/R_{P4}))$
$R_{upper} = 1 / ((0.772/8.921) + (0.110/6.021) + (0.103/8.933) + (0.015/6.033)) = 8.415$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1})) + 1 / ((F_{L2}/R_{L2}) + (F_{B2}/R_{B2}))$
$R_{lower} = 4.591 + 1 / ((0.875/4.150) + (0.125/1.250)) + 1 / ((0.882/0.180) + (0.118/0.192)) = 7.989$m²K/W

Total resistance of wall

$R_T = (R_{upper} + R_{lower}) / 2 = (8.415 + 7.989) / 2 = 8.20$ 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 : 28.500mm² Recess : 0.0mm
Delta Uf for Beltermo Ultra : 0.0043
Warm pitched roof - insulation over rafters
Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 6.700 per m² Af : 28.500mm² Recess : 0.0mm
Delta Uf for Beltermo Kombi : 0.0053
Correction for air gaps, Delta Ug = 0.0000W/m²K

U = (1 / Rt) + (Delta Uf + Delta Ug + Delta Up + Delta Urc2 + Delta Urc2) = (1/8.2023) + 0.0096 + 0.0000 + 0.0000 + 0.0000 + 0.0000 = 0.13 W/m²K

Structure element : Wall
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	20.00	51.50	5.90	85.50
Feb	20.00	50.40	5.70	83.50
Mar	20.00	51.50	6.90	82.00
Apr	20.00	53.30	8.80	79.50
May	20.00	58.10	11.50	79.00
Jun	20.00	65.10	14.30	79.50
Jul	20.00	71.00	16.10	80.50
Aug	20.00	71.40	16.00	81.50
Sep	20.00	67.50	14.30	83.00
Oct	20.00	62.60	11.90	85.00
Nov	20.00	55.20	8.50	84.50
Dec	20.00	53.20	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)
Airspace, heat flow horizontal, 50 mm thick	0.0 (50.0)	1.2	1008.0	0.0
Beltermo Ultra	0.0 (80.0)	180.0	2100.0	0.0
Beltermo Kombi	0.0 (80.0)	110.0	2100.0	0.0
SteicoFlex	0.0 (150.0)	60.0	2100.0	0.0
Ampatex Sinco	0.0 (-)	280.0	850.0	0.0
Airspace, heat flow horizontal, 25 mm thick	25.0 (25.0)	1.2	1008.0	30996.0
Oriented strandboard (OSB)	11.0 (11.0)	650.0	1700.0	12155000.0
Gyproc Wallboard	12.5 (12.5)	0.0	0.0	0.0
Airspace, heat flow horizontal, 25 mm thick	25.0 (25.0)	1.2	1008.0	30240.0
Total				12216236.0
kappa value				12.2162

Limiting condition: insulation

Admittance : 1.05 W/m²K Decrement : 0.12 factor Decrement delay : -15.56 hours

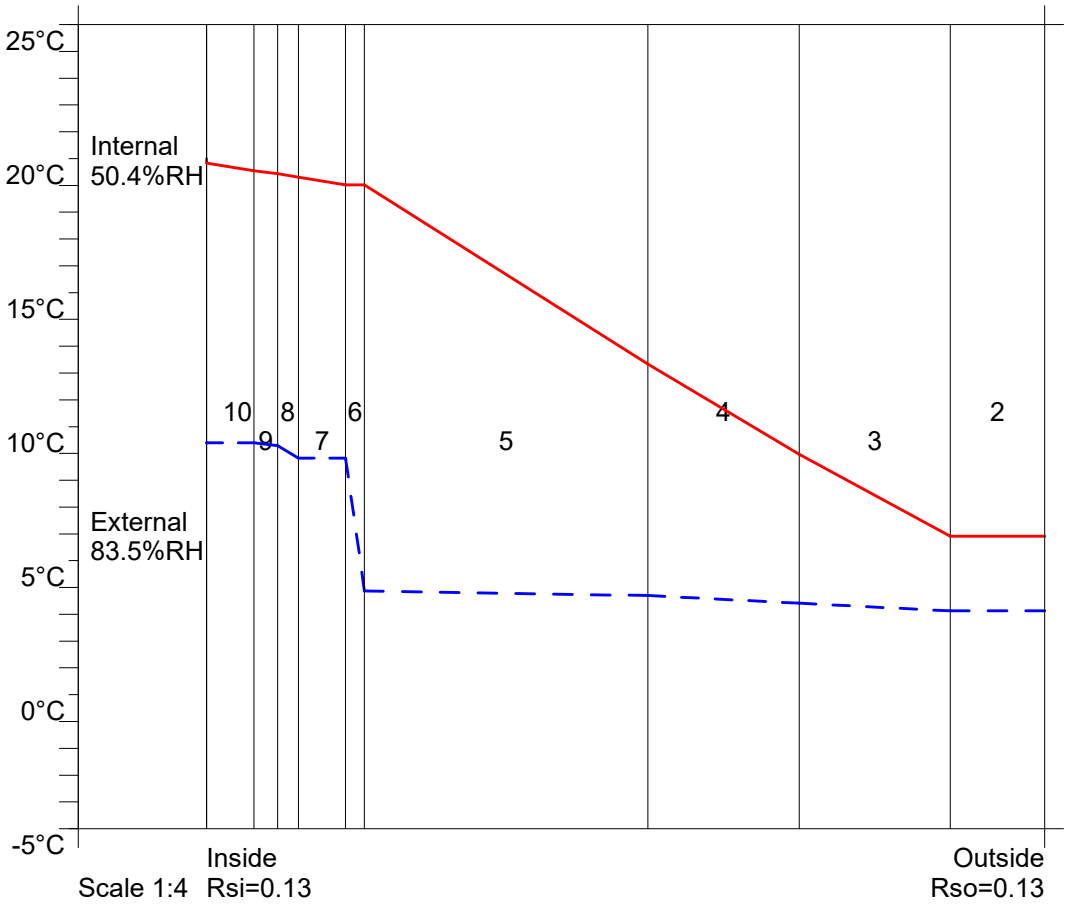
Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, Shops

Jan	Feb (worst)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 51.5%	20.0C 50.4%	20.0C 51.5%	20.0C 53.3%	20.0C 58.1%	20.0C 65.1%	20.0C 71.0%	20.0C 71.4%	20.0C 67.5%	20.0C 62.6%	20.0C 55.2%	20.0C 53.2%
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 Airspace, heat flow horizontal, 50 mm thick	5.9	3.1	0.76	0.93			No
3 Beltermo Ultra	9.0	3.4	0.78	1.14			No
4 Beltermo Kombi	12.3	3.7	0.80	1.43			No
5 SteicoFlex	19.0	3.9	0.81	2.20			No
6 Ampatex Sinco	19.0	8.8	1.13	2.20			No
7 Airspace, heat flow horizontal, 25 mm thick	19.3	8.8	1.13	2.24			No
8 Oriented strandboard (OSB)	19.4	9.3	1.17	2.26			No
9 Gyproc Wallboard	19.5	9.4	1.18	2.27			No
10 Airspace, heat flow horizontal, 25 mm thick	19.8	9.4	1.18	2.31			No
11 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 50.4%RH / 5.7°C @ 83.5%RH



Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, Shops

Jan	Feb (worst)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 51.5%	20.0C 50.4%	20.0C 51.5%	20.0C 53.3%	20.0C 58.1%	20.0C 65.1%	20.0C 71.0%	20.0C 71.4%	20.0C 67.5%	20.0C 62.6%	20.0C 55.2%	20.0C 53.2%
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 Airspace, heat flow horizontal, 50 mm thick	16.2	12.8	1.47	1.84			No
3 Beltermo Ultra	17.0	12.8	1.48	1.94			No
4 Beltermo Kombi	17.9	12.9	1.49	2.05			No
5 SteicoFlex	19.7	13.0	1.49	2.30			No
6 Ampatex Sinco	19.7	14.4	1.64	2.30			No
7 Airspace, heat flow horizontal, 25 mm thick	19.8	14.4	1.64	2.31			No
8 Oriented strandboard (OSB)	19.8	14.6	1.66	2.31			No
9 Gyproc Wallboard	19.9	14.6	1.66	2.32			No
10 Airspace, heat flow horizontal, 25 mm thick	20.0	14.6	1.66	2.33			No
11 Inside surface resistance							

Worst case internal / external conditions for graph : 20.0°C @ 71.0%RH / 16.1°C @ 80.5%RH