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

Project Information
Reference
Date 17 November 2023

Construction Type
Element : Wall - Walls-timber frame-175-render
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	-	-	0.040		
Render, lime-sand	8.0	0.800	0.010		
Beltermo Ultra	120.0	0.042	2.850		L:0 0.000W/m²K
SteicoFlex	175.0	0.036	4.850		12.500% Prefabricated panels (175.0mm) L:0 0.000W/m²K
Oriented strandboard (OSB)	11.0	0.130	0.085		
Ampatex Sinco	-	-	-		
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180		11.800% Softwood (25.0mm)
Gyproc Wallboard	12.5	0.190	0.066		
Inside surface resistance	-	-	0.130		
Total thickness	**351.5mm**				

U-value = 0.14W/m²K

U-value, Combined Method : 0.136W/m²K (upper/lower limit 7.548 / 7.120m²K/W, dUf 0.0035, dUg 0.0000, dUp0.0000, dUr0.0000, dUrc1 0.0000, dUrc2 0.0000)

Correction factors
Mechanical fasteners :-
Insulated fixings
Alpha : 0.00 per m lambda f : 50.0000W/mK nf : 9.000 per m² Af : 12.500mm² Recess : 10.0mm
Delta Uf for Beltermo Ultra : 0.0035
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	-	-	0.040	-	-
Render, lime-sand	8.0	0.800	0.010	50.00	0.40
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
Airspace, heat flow horizontal, 25 mm thick	25.0	-	0.180	-	0.00
Gyproc Wallboard	12.5	0.190	0.066	50.00	0.63
Inside surface resistance	-	-	0.130	-	-
Total thickness	**351.5mm**				

Detailed U-value Calculation Results

Construction includes 2 bridged layers

Non-bridged layers

Outside surface resistance	0.040 m²K/W
Render, lime-sand	0.010 m²K/W
Beltermo Ultra	2.850 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} =	3.181 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

$R_{P1} = R_{NB} + R_{L1} = 3.181 + 5.030 = 8.211$ m²K/W $F_{P1} = 77.175\%$
$R_{P2} = R_{NB} + R_{L2} = 3.181 + 1.638 = 4.819$ m²K/W $F_{P2} = 11.025\%$
$R_{P3} = R_{NB} + R_{L3} = 3.181 + 5.042 = 8.223$ m²K/W $F_{P3} = 10.325\%$
$R_{P4} = R_{NB} + R_{L4} = 3.181 + 1.651 = 4.831$ m²K/W $F_{P4} = 1.475\%$

Upper resistance limit

$R_{upper} = 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}) + (F_{P3}/R_{P3}) + (F_{P4}/R_{P4}))$
$R_{upper} = 1 / ((0.772/8.211) + (0.110/4.819) + (0.103/8.223) + (0.015/4.831)) = 7.548$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1})) + 1 / ((F_{L2}/R_{L2}) + (F_{B2}/R_{B2}))$
$R_{lower} = 3.181 + 1 / ((0.875/4.850) + (0.125/1.458)) + 1 / ((0.882/0.180) + (0.118/0.192)) = 7.120$m²K/W

Total resistance of wall

$R_T = (R_{upper} + R_{lower}) / 2 = (7.548 + 7.120) / 2 = 7.33$ m²K/W

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Insulated fixings
Alpha : 0.00 per m lambda f : 50.0000W/mK nf : 9.000 per m² Af : 12.500mm² Recess : 10.0mm
Delta Uf for Beltermo Ultra : 0.0035
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) = 0.14 W/m²K

Structure element : Wall
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	21.00	45.10	3.10	85.00
Feb	21.00	44.60	3.10	83.50
Mar	21.00	45.40	5.20	79.50
Apr	21.00	46.70	7.60	75.50
May	21.00	51.40	10.60	76.00
Jun	21.00	57.20	14.00	74.50
Jul	21.00	61.90	15.80	75.00
Aug	21.00	62.60	15.40	77.50
Sep	21.00	58.60	13.20	79.50
Oct	21.00	53.90	10.00	83.00
Nov	21.00	48.00	6.00	84.00
Dec	21.00	46.40	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)
Render, lime-sand	0.0 (8.0)	1600.0	1000.0	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)	11.0 (11.0)	650.0	1700.0	12155000.0
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	30240.0
Gyproc Wallboard	12.5 (12.5)	0.0	0.0	0.0
Total				12185240.0
kappa value				12.1852

Limiting condition: insulation

Admittance : 1.09 W/m²K Decrement : 0.15 factor Decrement delay : -14.63 hours

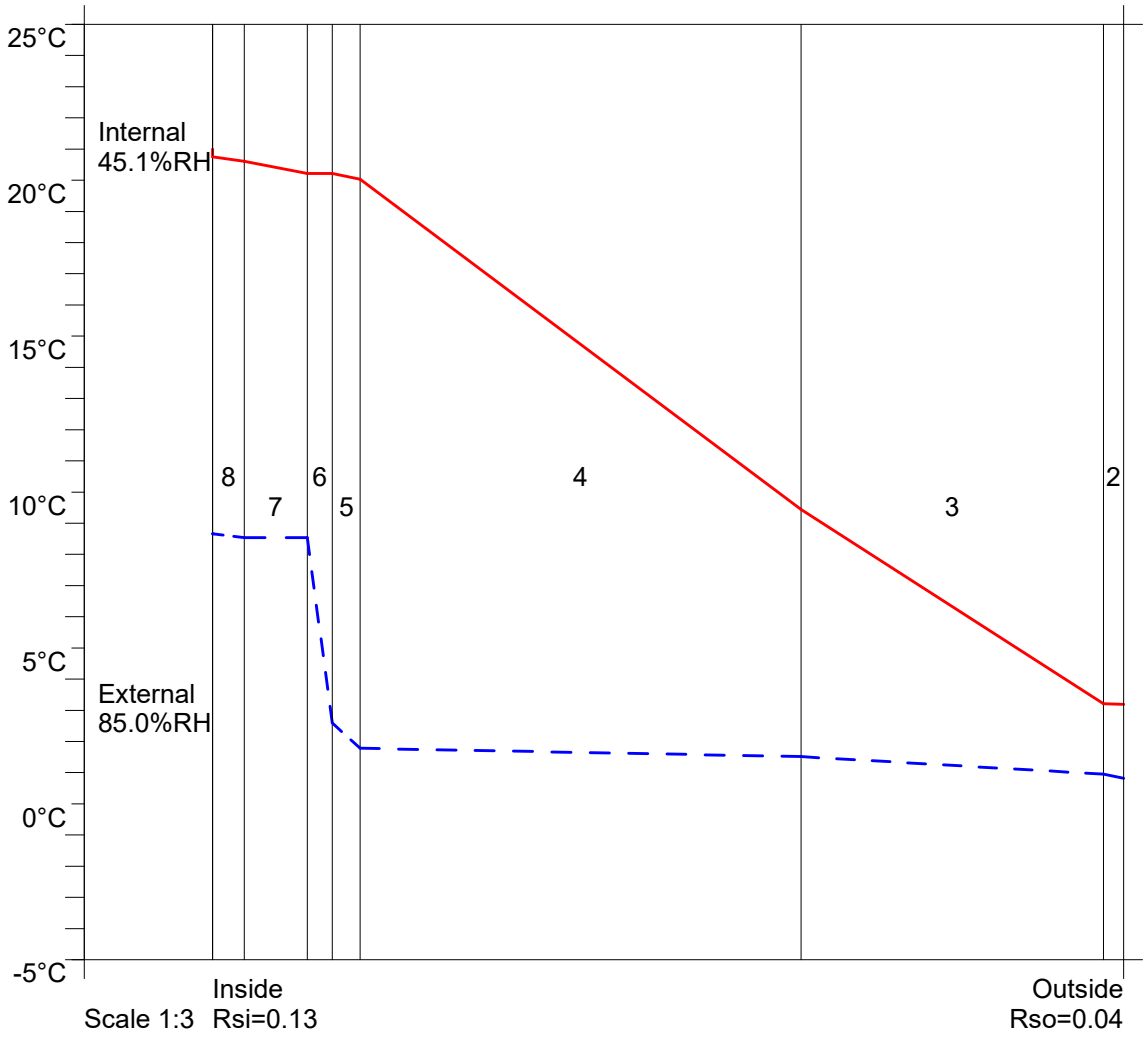
Condensation Risk Analysis (no account taken of thermal bridges)

2 - Offices, shops and dwellings with low occupancy

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21.0C 45.1%	21.0C 44.6%	21.0C 45.4%	21.0C 46.7%	21.0C 51.4%	21.0C 57.2%	21.0C 61.9%	21.0C 62.6%	21.0C 58.6%	21.0C 53.9%	21.0C 48.0%	21.0C 46.4%
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	3.2	0.8	0.65	0.77			No
2 Render, lime-sand	3.2	1.0	0.65	0.77			No
3 Beltermo Ultra	9.4	1.5	0.68	1.18			No
4 SteicoFlex	20.0	1.8	0.69	2.34			No
5 Oriented strandboard (OSB)	20.2	2.6	0.74	2.37			No
6 Ampatex Sinco	20.2	8.5	1.11	2.37			No
7 Airspace, heat flow horizontal, 25 mm thick	20.6	8.5	1.11	2.43			No
8 Gyproc Wallboard	20.8	8.7	1.12	2.45			No
9 Inside surface resistance							

Worst case internal / external conditions for graph : 21.0°C @ 45.1%RH / 3.1°C @ 85.0%RH



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21.0C 45.1%	21.0C 44.6%	21.0C 45.4%	21.0C 46.7%	21.0C 51.4%	21.0C 57.2%	21.0C 61.9%	21.0C 62.6%	21.0C 58.6%	21.0C 53.9%	21.0C 48.0%	21.0C 46.4%
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	15.8	11.4	1.35	1.80			No
2 Render, lime-sand	15.8	11.4	1.35	1.80			No
3 Beltermo Ultra	17.6	11.5	1.36	2.02			No
4 SteicoFlex	20.7	11.6	1.36	2.44			No
5 Oriented strandboard (OSB)	20.8	11.8	1.38	2.45			No
6 Ampatex Sinco	20.8	13.4	1.53	2.45			No
7 Airspace, heat flow horizontal, 25 mm thick	20.9	13.4	1.53	2.47			No
8 Gyproc Wallboard	20.9	13.4	1.54	2.47			No
9 Inside surface resistance							

Worst case internal / external conditions for graph : 21.0°C @ 61.9%RH / 15.8°C @ 75.0%RH