

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-140-render

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 | - | - | 0.040 | | |
| Render, lime-sand | 8.0 | 0.800 | 0.010 | | |
| Beltermo Ultra | 100.0 | 0.042 | 2.350 | | L:0 0.000W/m ² K |
| SteicoFlex | 140.0 | 0.036 | 3.850 | | 12.500% Prefabricated panels (140.0mm) L:0 0.000W/m ² K |
| 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 | 296.5mm | | | | |

U-value = 0.17W/m²K

U-value, Combined Method : 0.166W/m²K (upper/lower limit 6.196 / 5.852m²K/W, dUf 0.0040, dUg 0.0000, dUp0.0000, dUr0.0000, dUrc1 0.0000, dUrc2 0.0000)

Correction factors

Mechanical fasteners :-

Insulated fixings

Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 9.000 per m² Af : 12.500mm² Recess : 10.0mm

Delta Uf for Beltermo Ultra : 0.0040

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 | - | - | 0.040 | - | - |
| Render, lime-sand | 8.0 | 0.800 | 0.010 | 50.00 | 0.40 |
| Beltermo Ultra | 100.0 | 0.042 | 2.350 | 15.00 | 1.50 |
| SteicoFlex | 140.0 | 0.036 | 3.850 | 5.00 | 0.70 |
| 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 | 296.5mm | | | | |

Detailed U-value Calculation Results

Construction includes 2 bridged layers

Non-bridged layers

| | |
|---|-------------------------------|
| Outside surface resistance | 0.040 m ² K/W |
| Render, lime-sand | 0.010 m ² K/W |
| Beltermo Ultra | 2.350 m ² K/W |
| Oriented strandboard (OSB) | 0.085 m ² K/W |
| Gyproc Wallboard | 0.066 m ² K/W |
| Inside surface resistance | 0.130 m ² K/W |
| Resistance of non-bridged layers, R_{NB} = | 2.681 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

$$R_{P1} = R_{NB} + R_{L1} = 2.681 + 4.030 = 6.711 \text{ m}^2\text{K/W} \quad F_{P1} = 77.175\%$$

$$R_{P2} = R_{NB} + R_{L2} = 2.681 + 1.347 = 4.027 \text{ m}^2\text{K/W} \quad F_{P2} = 11.025\%$$

$$R_{P3} = R_{NB} + R_{L3} = 2.681 + 4.042 = 6.723 \text{ m}^2\text{K/W} \quad F_{P3} = 10.325\%$$

$$R_{P4} = R_{NB} + R_{L4} = 2.681 + 1.359 = 4.040 \text{ m}^2\text{K/W} \quad F_{P4} = 1.475\%$$

Upper resistance limit

$$R_{\text{upper}} = 1 / \left((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}) + (F_{P3}/R_{P3}) + (F_{P4}/R_{P4}) \right)$$

$$R_{\text{upper}} = 1 / \left((0.772/6.711) + (0.110/4.027) + (0.103/6.723) + (0.015/4.040) \right) = 6.196 \text{ m}^2\text{K/W}$$

Lower resistance limit

$$R_{\text{lower}} = R_{NB} + 1 / \left((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}) \right) + 1 / \left((F_{L2}/R_{L2}) + (F_{B2}/R_{B2}) \right)$$

$$R_{\text{lower}} = 2.681 + 1 / \left((0.875/3.850) + (0.125/1.167) \right) + 1 / \left((0.882/0.180) + (0.118/0.192) \right) = 5.852 \text{ m}^2\text{K/W}$$

Total resistance of wall

$$R_T = (R_{\text{upper}} + R_{\text{lower}}) / 2 = (6.196 + 5.852) / 2 = 6.02 \text{ m}^2\text{K/W}$$

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Insulated fixings

Alpha : 0.80 per m lambda f : 50.0000W/mK nf : 9.000 per m² Af : 12.500mm² Recess : 10.0mm

Delta Uf for Beltermo Ultra : 0.0040

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) = 0.17 W/m²K

Structure element : Wall
Condensation calculations performed in accordance with BS5250:2021

Condensation is occurring 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/m ³) | Specific heat capacity (J/kgK) | Heat capacity (kJ/m ² K) |
|---|--|---------------------------------|--------------------------------------|---|
| Render, lime-sand | 0.0 (8.0) | 1600.0 | 1000.0 | 0.0 |
| Beltermo Ultra | 0.0 (100.0) | 180.0 | 2100.0 | 0.0 |
| SteicoFlex | 0.0 (140.0) | 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 : 1.08 W/m²K Decrement : 0.26 factor Decrement delay : -11.75 hours

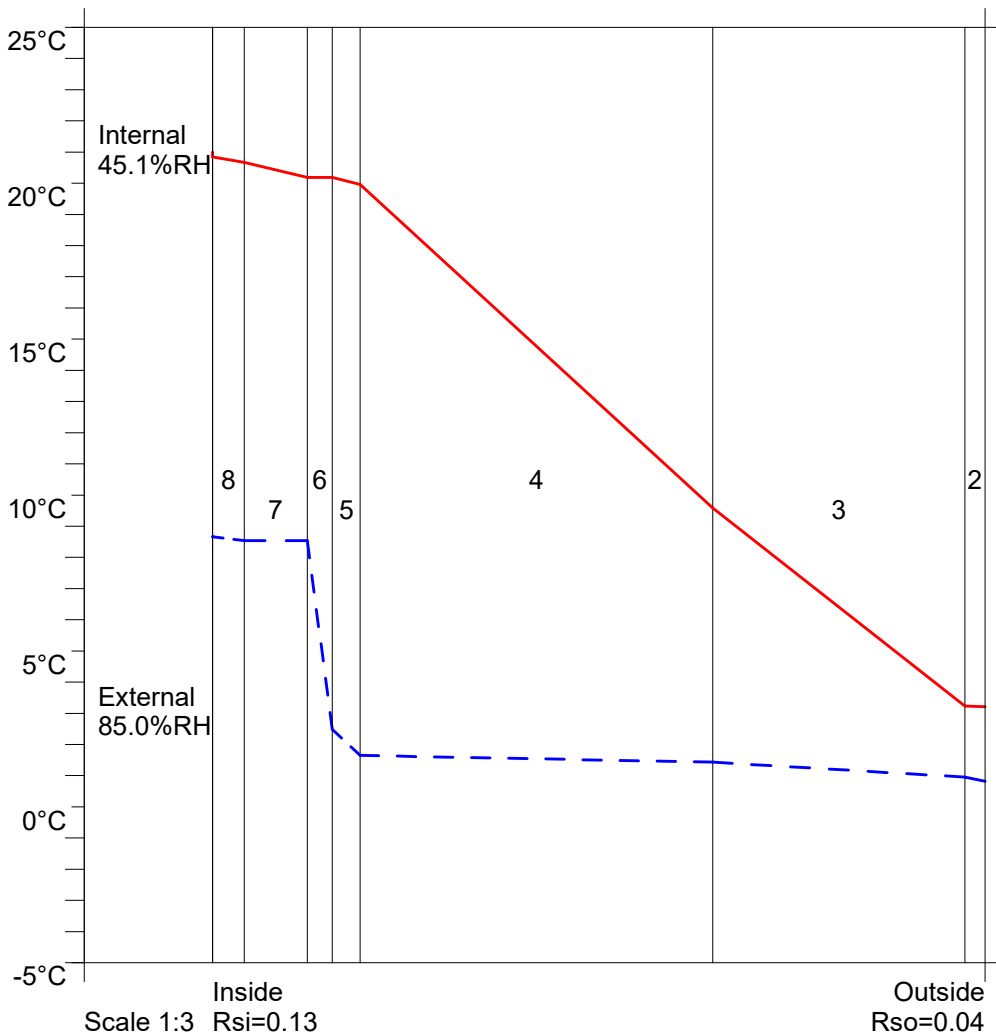
Condensation Risk Analysis (no account taken of thermal bridges)

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. °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 Render, lime-sand | 3.2 | 0.8 | 0.65 | 0.77 | | | No |
| 3 Beltermo Ultra | 3.2 | 1.0 | 0.65 | 0.77 | | | No |
| 4 SteicoFlex | 9.6 | 1.4 | 0.68 | 1.19 | | | No |
| 5 Oriented strandboard (OSB) | 20.0 | 1.6 | 0.69 | 2.33 | | | No |
| 6 Ampatex Sinco | 20.2 | 2.5 | 0.73 | 2.36 | | | No |
| 7 Airspace, heat flow horizontal, 25 mm thick | 20.2 | 8.5 | 1.11 | 2.36 | | | No |
| 8 Gyproc Wallboard | 20.7 | 8.5 | 1.11 | 2.43 | | | No |
| 9 Inside surface resistance | 20.8 | 8.7 | 1.12 | 2.46 | | | No |

Worst case internal / external conditions for graph : 21.0°C @ 45.1%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 |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 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. °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 Render, lime-sand | 15.8 | 11.4 | 1.35 | 1.80 | | | No |
| 3 Beltermo Ultra | 15.8 | 11.4 | 1.35 | 1.80 | | | No |
| 4 SteicoFlex | 17.7 | 11.5 | 1.36 | 2.02 | | | No |
| 5 Oriented strandboard (OSB) | 20.7 | 11.6 | 1.36 | 2.44 | | | No |
| 6 Ampatex Sinco | 20.8 | 11.8 | 1.38 | 2.45 | | | No |
| 7 Airspace, heat flow horizontal, 25 mm thick | 20.8 | 13.4 | 1.53 | 2.45 | | | No |
| 8 Gyproc Wallboard | 20.9 | 13.4 | 1.53 | 2.47 | | | No |
| 9 Inside surface resistance | 21.0 | 13.4 | 1.54 | 2.48 | | | No |

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

