**Back to Earth SW Ltd**
7 Tuns Lane
Silverton, Exeter
Devon. EX5 4HY

***Project Information***
Reference
Date 14 September 2018

***Construction Type***
Element : Wall - 0 Spec generator copies
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 | | |
| Render, lime-sand | 7.0 | 0.800 | 0.009 | | |
| Diffutherm | 60.0 | 0.043 | 1.350 | | L:0 0.000W/m²K |
| Render, lime-sand | 15.0 | 0.800 | 0.019 | | |
| Blockwork - outer leaf, medium | 100.0 | 0.500 | 0.200 | | 6.700% Mortar (10.0mm) |
| Superwhite 40 - Cavity Wall | 50.0 | 0.040 | 1.250 | | L:1 0.010W/m²K |
| Brick inner leaf | 100.0 | 0.560 | 0.179 | | |
| Render, lime-sand | 25.0 | 0.800 | 0.031 | | |
| Inside surface resistance | - | - | 0.130 | | |
| **Total thickness** | **357.0mm** | | | | |

***U-value = 0.30W/m²K***

U-value, Combined Method : 0.304W/m²K (upper/lower limit 3.291 / 3.287m²K/W, dUf 0.0062, dUg 0.0014, 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 : 17.0000W/mK nf : 6.700 per m² Af : 7.450mm² Recess : 0.0mm
Delta Uf for Diffutherm : 0.0019
Wall with cavity fill, mild steel double triangle ties, 900 x 450 cntrs - walls upto 15m with >=90mm leaves
Alpha : 0.80 per m lambda f : 60.0000W/mK nf : 2.500 per m² Af : 12.500mm² Recess : 0.0mm
Delta Uf for Superwhite 40 - Cavity Wall : 0.0043
nf = fasteners per m² Af = fasteners cross-sectional area
Air gaps, Delta Ug = 0.001W/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 | - | - |
| Render, lime-sand | 7.0 | 0.800 | 0.009 | 50.00 | 0.35 |
| Diffutherm | 60.0 | 0.043 | 1.350 | 25.00 | 1.50 |
| Render, lime-sand | 15.0 | 0.800 | 0.019 | 50.00 | 0.75 |
| Blockwork - outer leaf, medium | 100.0 | 0.500 | 0.200 | 50.00 | 5.00 |
| Superwhite 40 - Cavity Wall | 50.0 | 0.040 | 1.250 | 5.00 | 0.25 |
| Brick inner leaf | 100.0 | 0.560 | 0.179 | 50.00 | 5.00 |
| Render, lime-sand | 25.0 | 0.800 | 0.031 | 50.00 | 1.25 |
| Inside surface resistance | - | - | 0.130 | - | - |
| **Total thickness** | **357.0mm** | | | | |

**Detailed U-value Calculation Results**

Construction includes 1 bridged layer

Non-bridged layers

| | |
|---|---|
| Outside surface resistance | 0.130 m²K/W |
| Render, lime-sand | 0.009 m²K/W |
| Diffutherm | 1.350 m²K/W |
| Render, lime-sand | 0.019 m²K/W |
| Superwhite 40 - Cavity Wall | 1.250 m²K/W |
| Brick inner leaf | 0.179 m²K/W |
| Render, lime-sand | 0.031 m²K/W |
| Inside surface resistance | 0.130 m²K/W |
| Resistance of non-bridged layers, $R_{NB}$ = | 3.098 m²K/W |

Bridged layer

Blockwork - outer leaf, medium (L1) bridged by Mortar (B1)

Path 1 - Blockwork
Path 2 - Mortar

Resistance and fraction of heat flow paths

$R_{P1} = R_{NB} + R_{L1} = 3.098 + 0.200 = 3.298$ m²K/W $F_{P1} = 93.300\%$
$R_{P2} = R_{NB} + R_{L2} = 3.098 + 0.106 = 3.204$ m²K/W $F_{P2} = 6.700\%$

Upper resistance limit

$R_{upper} = 1 / ( (F_{P1}/R_{P1}) + (F_{P2}/R_{P2}) )$
$R_{upper} = 1 / ( (0.933/3.298) + (0.067/3.204) ) = 3.291$m²K/W

Lower resistance limit

$R_{lower} = R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1}))$
$R_{lower} = 3.098 + 1 / ((0.933/0.200) + (0.067/0.106)) = 3.287$m²K/W

Total resistance of wall

$R_T = ( R_{upper} + R_{lower} ) / 2 = (3.291 + 3.287) / 2 = 3.29$ m²K/W

Mechanical fasteners :-

Calculations to BS EN ISO 6946:2007

Warm pitched roof - insulation over rafters
Alpha : 0.80 per m lambda f : 17.0000W/mK nf : 6.700 per m² Af : 7.450mm² Recess : 0.0mm
Delta Uf for Diffutherm : 0.0019
Wall with cavity fill, mild steel double triangle ties, 900 x 450 cntrs - walls upto 15m with >=90mm leaves
Alpha : 0.80 per m lambda f : 60.0000W/mK nf : 2.500 per m² Af : 12.500mm² Recess : 0.0mm
Delta Uf for Superwhite 40 - Cavity Wall : 0.0043
Correction for air gaps, Delta Ug = 0.0014W/m²K

(Delta Uf + Delta Ug + Delta Up + Delta Ur) is less than 3% of (1 / Rt) so U = (1 / Rt) + (Delta Ur) + (Delta Urc) = 0.30 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 | 21.00 | 54.70 | 3.50 | 86.00 |
| Feb | 21.00 | 53.80 | 3.80 | 82.50 |
| Mar | 21.00 | 53.90 | 5.70 | 80.00 |
| Apr | 21.00 | 54.40 | 8.00 | 77.00 |
| May | 21.00 | 57.90 | 11.30 | 77.00 |
| Jun | 21.00 | 62.20 | 14.40 | 76.00 |
| Jul | 21.00 | 66.80 | 16.50 | 76.50 |
| Aug | 21.00 | 67.40 | 16.10 | 78.50 |
| Sep | 21.00 | 64.60 | 13.80 | 81.50 |
| Oct | 21.00 | 60.80 | 10.70 | 84.00 |
| Nov | 21.00 | 56.50 | 6.40 | 85.50 |
| Dec | 21.00 | 55.50 | 4.50 | 86.50 |

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 (7.0) | 1600.0 | 1000.0 | 0.0 |
| Diffutherm | 0.0 (60.0) | 190.0 | 2100.0 | 0.0 |
| Render, lime-sand | 0.0 (15.0) | 1600.0 | 1000.0 | 0.0 |
| Blockwork - outer leaf, medium | 0.0 (100.0) | 1400.0 | 840.0 | 0.0 |
| Superwhite 40 - Cavity Wall | 0.0 (50.0) | 0.0 | 0.0 | 0.0 |
| Brick inner leaf | 75.0 (100.0) | 1700.0 | 840.0 | 107100000.0 |
| Render, lime-sand | 25.0 (25.0) | 1600.0 | 1000.0 | 40000000.0 |
| Total | | | | 147100000.0 |
| kappa value | | | | 147.1000 |

Limiting condition: 100mm in

Admittance : 4.43 W/m²K Decrement : 0.22 factor Decrement delay : -12.33 hours

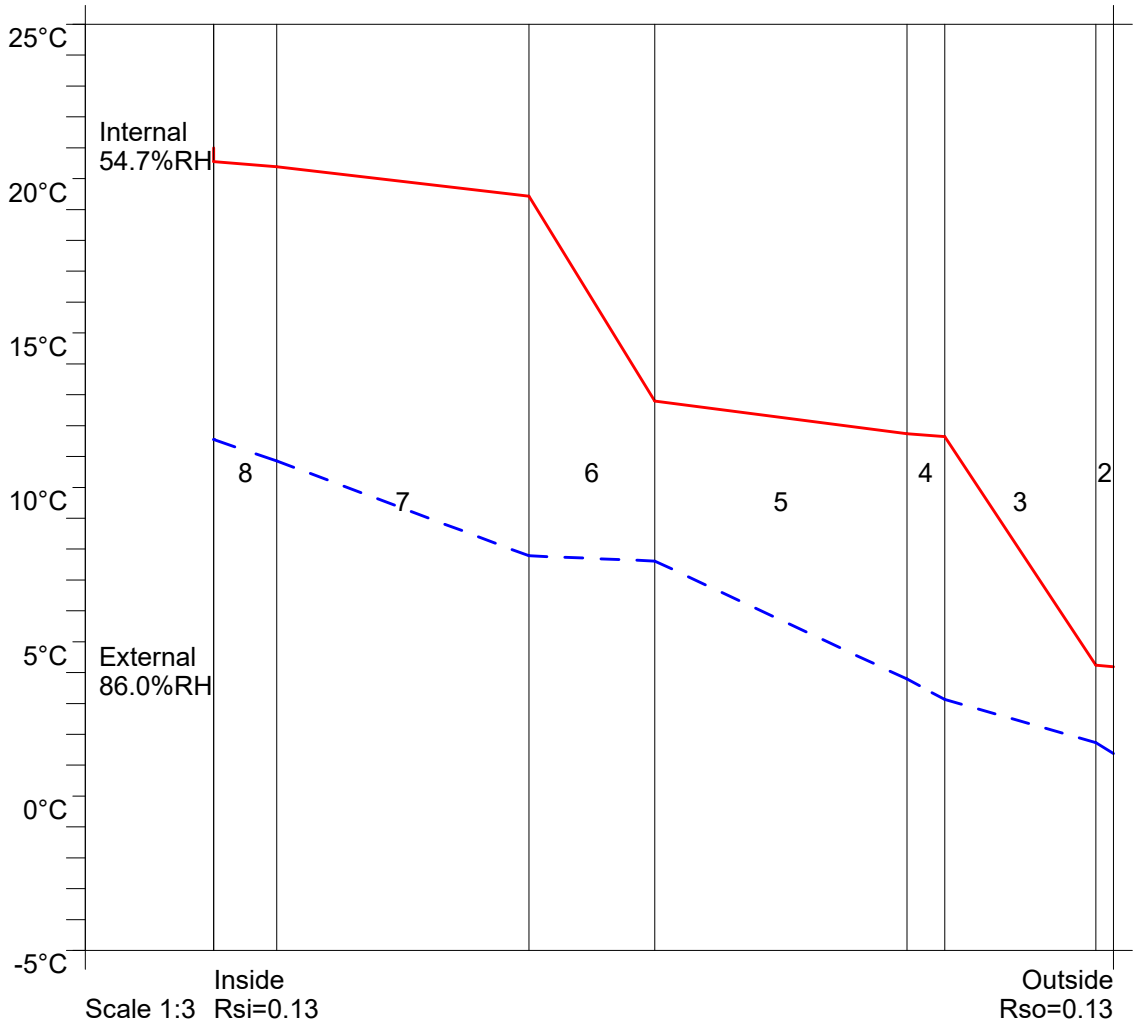
**Condensation Risk Analysis (no account taken of thermal bridges)**

3 - Dwellings with low occupancy

| Jan (worst) | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21.0C 54.7% | 21.0C 53.8% | 21.0C 53.9% | 21.0C 54.4% | 21.0C 57.9% | 21.0C 62.2% | 21.0C 66.8% | 21.0C 67.4% | 21.0C 64.6% | 21.0C 60.8% | 21.0C 56.5% | 21.0C 55.5% |
| 3.5C 86.0% | 3.8C 82.5% | 5.7C 80.0% | 8.0C 77.0% | 11.3C 77.0% | 14.4C 76.0% | 16.5C 76.5% | 16.1C 78.5% | 13.8C 81.5% | 10.7C 84.0% | 6.4C 85.5% | 4.5C 86.5% |

| | 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 | 4.2 | 1.4 | 0.67 | 0.82 | | | No |
| 2 Render, lime-sand | 4.2 | 1.7 | 0.69 | 0.83 | | | No |
| 3 Diffutherm | 11.6 | 3.1 | 0.76 | 1.37 | | | No |
| 4 Render, lime-sand | 11.7 | 3.8 | 0.80 | 1.38 | | | No |
| 5 Blockwork - outer leaf, medium | 12.8 | 7.6 | 1.04 | 1.48 | | 0 in Jan | No |
| 6 Superwhite 40 - Cavity Wall (Delta U" = 0.010W/m²K) | 19.4 | 7.8 | 1.06 | 2.26 | | | No |
| 7 Brick inner leaf | 20.4 | 10.9 | 1.30 | 2.39 | | | No |
| 8 Render, lime-sand | 20.5 | 11.5 | 1.36 | 2.42 | | | No |
| 9 Inside surface resistance | | | | | | | |

Worst case internal / external conditions for graph : 21.0°C @ 54.7%RH / 3.5°C @ 86.0%RH



**Condensation Risk Analysis (no account taken of thermal bridges)**

3 - Dwellings with low occupancy

| Jan (worst) | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21.0C 54.7% | 21.0C 53.8% | 21.0C 53.9% | 21.0C 54.4% | 21.0C 57.9% | 21.0C 62.2% | 21.0C 66.8% | 21.0C 67.4% | 21.0C 64.6% | 21.0C 60.8% | 21.0C 56.5% | 21.0C 55.5% |
| 3.5C 86.0% | 3.8C 82.5% | 5.7C 80.0% | 8.0C 77.0% | 11.3C 77.0% | 14.4C 76.0% | 16.5C 76.5% | 16.1C 78.5% | 13.8C 81.5% | 10.7C 84.0% | 6.4C 85.5% | 4.5C 86.5% |

| | 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 | 16.7 | 12.4 | 1.44 | 1.90 | | | No |
| 2 Render, lime-sand | 16.7 | 12.4 | 1.44 | 1.90 | | | No |
| 3 Diffutherm | 18.6 | 12.7 | 1.46 | 2.14 | | | No |
| 4 Render, lime-sand | 18.6 | 12.8 | 1.48 | 2.14 | | | No |
| 5 Blockwork - outer leaf, medium | 18.9 | 13.6 | 1.56 | 2.18 | | 0 in Jan | No |
| 6 Superwhite 40 - Cavity Wall (Delta U" = 0.010W/m²K) | 20.6 | 13.7 | 1.56 | 2.42 | | | No |
| 7 Brick inner leaf | 20.8 | 14.4 | 1.64 | 2.46 | | | No |
| 8 Render, lime-sand | 20.9 | 14.6 | 1.66 | 2.47 | | | No |
| 9 Inside surface resistance | | | | | | | |

Worst case internal / external conditions for graph : 21.0°C @ 66.8%RH / 16.5°C @ 76.5%RH