# BuildDesk U 3.4

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - Pitched roofs**
Component: **Solarcrest roof asmly**



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This illustration of inhomogeneous layers is provided only to assist in visualising the arrangement.

On the basis of the given information about the inhomogeneous layers, it is not possible to estimate how and where bearing elements intersect each other. It was assumed that the layers intersect crosswise. The size of the areas was calculated corresponding to their percentage of the whole area.

## Assignment: Pitched roof < 70°, with insulation between rafters

| | | Manufacturer | Name | Thickness [m], number | Lambda [W/(mK)] | Q | R [m²K/W] |
|---|---|---|---|---|---|---|---|
| | | Rse | | | | | 0.1000 |
| ☐ | 1 | BS EN 12524 | Tiles (roofing), clay | 0.0150 | 1.000 | D | ~~0.0150~~ |
| ☐ | 2 | Inhomogeneous material layer | consisting of: | 0.0250 | ø 0.022 | | ~~1.1515~~ |
| | 2a | BS EN ISO 6946 | Well ventilated air layer | 83.30 % | 0.000 | D | - |
| | 2b | BS EN 12524 | Softwood Timber [500 kg/m³] | 16.70 % | 0.130 | D | - |
| ☑ | 3 | DuPont Tyvek | Tyvek Supro | 0.0005 | 0.100 | C | 0.0045 |
| ☑ | 4 | Inhomogeneous material layer | consisting of: | 0.1250 | ø 0.050 | | 2.4814 |
| | 4a | Demilec | Sealection | 87.50 % | 0.039 | E | - |
| | 4b | BS EN 12524 | Softwood Timber [500 kg/m³] | 12.50 % | 0.130 | D | - |
| ☑ | 5 | Demilec | Sealection | 0.0800 | 0.039 | E | 2.0513 |
| ☑ | 6 | Inhomogeneous material layer | consisting of: | 0.0250 | ø 0.050 | | 0.4963 |
| | 6a | Demilec | Sealection | 87.50 % | 0.039 | E | - |
| | 6b | BS EN 12524 | Softwood Timber [500 kg/m³] | 12.50 % | 0.130 | D | - |
| ☑ | 7 | BS EN 12524 | Polyethylene 0.15 mm | 0.0002 | 0.170 | D | 0.0009 |
| ☑ | 8 | BS EN 12524 | Gypsum plasterboard | 0.0125 | 0.250 | D | 0.0500 |
| | | Rsi | | | | | 0.1000 |
| | | | | **0.2831** | | | |

☐ was not taken into consideration in the calculation

$R_T = (R_T' + R_T'')/2 = 5.45$ m²K/W

$U = 1/R_T = 0.18$ W/(m²K)

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
A .. A: Data is entered and validated by the manufacturer or supplier. Data is continuously tested by 3rd party.
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$U_{max}$ = **0.20** W/(m²K) U = **0.18** W/(m²K) $R_T$= **5.45** m²K/W

**Source of Umax value:** England and Wales Approved Document L1A 2010 Tab 2 Dwellings New

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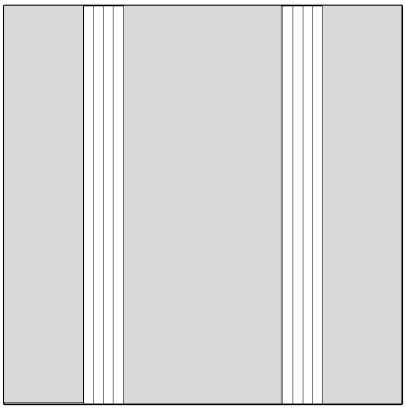
Component: **Solarcrest roof asmly**

Draft of the component (portion in %):




The inhomogeneous layer consists of two zones (A, B).
The portion is given in %.

| | | |
|---|---|---|
| A | 21.88 + 43.75 + 21.88<br>consisting of material layers: 3, 4a, 5, 6a, 7, 8 | = 87.50% |
| B | 6.25 + 6.25<br>consisting of material layers: 3, 4b, 5, 6b, 7, 8 | = 12.50% |

**Upper limit of the thermal transfer resistance R**

$U_A$ [W/(m$^2$K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{5.95 + 0.1 + 0.1}$ = 0.16

$U_B$ [W/(m$^2$K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{3.26 + 0.1 + 0.1}$ = 0.29

$$R_T' = \frac{1}{A * U_A + B * U_B} = 5.61 \text{ m}^2\text{K/W}$$

**Lower limit of the thermal transfer resistance R**

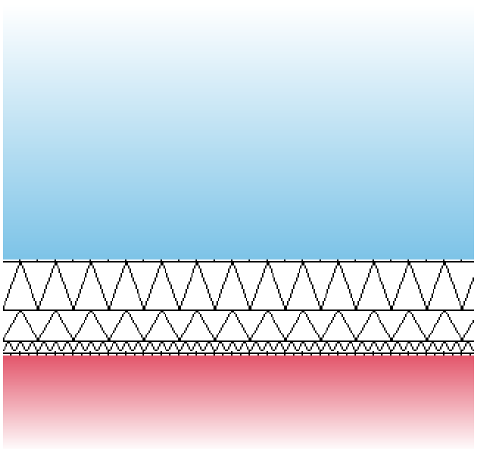
| | | |
|---|---|---|
| $R_{se}$ [m$^2$K/W] | | = 0.1 |
| $R_3$" [m$^2$K/W] = $d_3 / \lambda_3$= | 0.0005 / 0.100 | = 0.00 |
| $R_4$" [m$^2$K/W] = $d_4/(\lambda_{4a} * A + \lambda_{4b} * B)$ = | 0.1250 /( 0.039 * 87.50% + 0.130 * 12.50%) | = 2.48 |
| $R_5$" [m$^2$K/W] = $d_5 / \lambda_5$= | 0.0800 / 0.039 | = 2.05 |
| $R_6$" [m$^2$K/W] = $d_6/(\lambda_{6a} * A + \lambda_{6b} * B)$ = | 0.0250 /( 0.039 * 87.50% + 0.130 * 12.50%) | = 0.50 |
| $R_7$" [m$^2$K/W] = $d_7 / \lambda_7$= | 0.0002 / 0.170 | = 0.00 |
| $R_8$" [m$^2$K/W] = $d_8 / \lambda_8$= | 0.0125 / 0.250 | = 0.05 |
| $R_{si}$ [m$^2$K/W] | | = 0.1 |

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 5.28 \text{ m}^2\text{K/W}$$

Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - Pitched roofs**
Component: **Solarcrest roof asmly**



OUTSIDE



INSIDE

The list of material layers shown below may differ from those in the U-value calculation printout. Only material layers which are used in the Condensation Risk Analysis are listed.

This calculation of the Condensation risk analysis according to BS EN ISO 13788:2002 has been performed on a construction containing inhomogeneous layers. This calculation is only valid through the selected section. It is advisable that you should also select the alternative position and recalculate the Condensation Risk Analysis for a more complete assessment of the construction.

The CRA calculation for pitched roofs can be very unreliable and caution should be used when interpreting these results. For further guidance the user is advised to follow the recommendation of BS 5250:202 (currently under review).

## Assignment: Pitched roof < 70°, with insulation between rafters

| Name | Thickn. [m] | lambda [W/(mK)] | Q | µ [-] | Q | sd [m] | R [m²K/W] |
|---|---|---|---|---|---|---|---|
| Tyvek Supro | 0.0005 | 0.100 | C | 89.00 | C | 0.04 | 0.0045 |
| Sealection | 0.1250 | 0.039 | E | 6.00 | E | 0.75 | 3.2051 |
| Sealection | 0.0800 | 0.039 | E | 6.00 | E | 0.48 | 2.0513 |
| Sealection | 0.0250 | 0.039 | E | 6.00 | E | 0.15 | 0.6410 |
| Polyethylene 0.15 mm | 0.0002 | 0.170 | D | 300000.00 | D | 45.00 | 0.0009 |
| Gypsum plasterboard | 0.0125 | 0.250 | D | 4.00 | D | 0.05 | 0.0500 |

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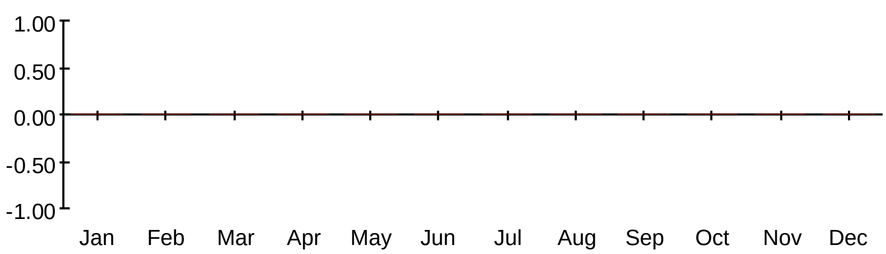
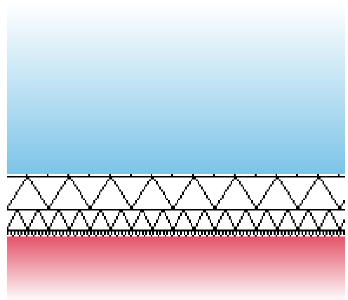
# Condensation risk analysis - summary of main results
# Calculation according BS EN ISO 13788

**Surface temperature to avoid critical surface moisture:**
**No danger of mould growth is expected.**

**Interstitial condensation:**
**No condensation is predicted at any interface in any month.**

**Interstitial condensation and evaporation per month gc [g/m²]**



**Component, condensation range**

**CRA calculations according to BS EN ISO 13788:2002 are used as a guide in predicting interstitial condensation. This methodology uses some simplifications of the dynamic processes involved and subsequently does have some limitations. Further information can be found in Information Paper IP 2/05 'Modelling and controlling interstitial condensation in buildings'' Feb 2005.**

**The CRA calculation for pitched roofs can be very unreliable and caution should be used when interpreting these results. For further guidance the user is advised to follow the recommendation of BS 5250:202 (currently under review).**

# Surface temperature to avoid critical surface humidity
# Calculation according BS EN ISO 13788

**Location: Manchester Airport; Humidity class according BS EN ISO 13788 annex A: Dwellings with low occupancy**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | Te | phi_e | Ti | phi_i | pe | delta p | pi | ps(Tsi) | Tsi,min | fRsi | Tsi | Tse |
| | | [°C] | --- | [°C] | --- | [Pa] | [Pa] | [Pa] | [Pa] | [°C] | --- | [°C] | [°C] |
| I | January | 4.2 | 0.830 | 20.0 | 0.594 | 684 | 704 | 1388 | 1735 | 15.3 | 0.701 | 19.4 | 4.3 |
| | February | 4.1 | 0.800 | 20.0 | 0.583 | 655 | 708 | 1363 | 1704 | 15.0 | 0.685 | 19.4 | 4.2 |
| | March | 5.8 | 0.760 | 20.0 | 0.570 | 701 | 633 | 1333 | 1666 | 14.7 | 0.623 | 19.4 | 5.9 |
| | April | 7.8 | 0.710 | 20.0 | 0.554 | 751 | 544 | 1294 | 1618 | 14.2 | 0.524 | 19.5 | 7.9 |
| | May | 11.3 | 0.680 | 20.0 | 0.555 | 910 | 388 | 1298 | 1622 | 14.2 | 0.337 | 19.7 | 11.4 |
| | June | 14.1 | 0.710 | 20.0 | 0.601 | 1142 | 263 | 1405 | 1756 | 15.5 | 0.231 | 19.8 | 14.1 |
| | July | 16.1 | 0.720 | 20.0 | 0.638 | 1317 | 174 | 1491 | 1863 | 16.4 | 0.075 | 19.8 | 16.1 |
| | August | 15.8 | 0.740 | 20.0 | 0.648 | 1328 | 187 | 1515 | 1894 | 16.6 | 0.201 | 19.8 | 15.8 |
| | September | 13.3 | 0.770 | 20.0 | 0.631 | 1175 | 298 | 1474 | 1842 | 16.2 | 0.435 | 19.7 | 13.3 |
| | October | 10.3 | 0.810 | 20.0 | 0.619 | 1014 | 432 | 1446 | 1808 | 15.9 | 0.579 | 19.6 | 10.4 |
| | November | 6.7 | 0.820 | 20.0 | 0.598 | 804 | 593 | 1397 | 1746 | 15.4 | 0.652 | 19.5 | 6.8 |
| | December | 5.2 | 0.840 | 20.0 | 0.600 | 743 | 659 | 1402 | 1752 | 15.4 | 0.691 | 19.4 | 5.3 |

- The critical month is January with $f_{Rsi,max}$ = 0.701
  $f_{Rsi}$ = 0.960

## $f_{Rsi}$ > $f_{Rsi,max}$, the component complies.

**Nr Explanation**
1 External temperature
2 External rel. humidity
3 Internal temperature
4 Internal relative humidity
5 External partial pressure $p_e = \phi_e * p_{sat}(T_e)$; $p_{sat}(T_e)$ according formula E.7 and E.8 of BS EN ISO 13788
6 Partial pressure difference. The security factor of 1.10 according to BS EN ISO 13788, ch.4.2.4 is already included.
7 Internal partial pressure $p_i = \phi_i * p_{sat}(T_i)$; $p_{sat}(T_i)$ according formula E.7 and E.8 of BS EN ISO 13788
8 Minimum saturation pressure on the surface obtained by $p_{sat}(T_{si}) = p_i / \phi_{si}$,
where $\phi_{si}$ = 0.8 (critical surface humidity)
9 Minimum surface temperature as function of $p_{sat}(T_{si})$, formula E.9 and E.10 of BS EN ISO 13788
10 Design temperature factor according 3.1.2 of BS EN ISO 13788
11 Internal surface temperature, obtained from $T_{si} = T_i - R_{si} * U * (T_i - T_e)$
12 External surface temperature, obtained from $T_{se} = T_e + R_{se} * U * (T_i - T_e)$

# Interstitial condensation - main results
# Calculation according BS EN ISO 13788

**No condensation is predicted at any interface in any month.**

**Climcatic conditions**
**Location: Manchester Airport; Humidity class according BS EN ISO 13788 annex A: Dwellings with low occupancy**

| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Internal temperature [°C] | Ti | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Internal rel. humidity [%] | phi_i | 59.4 | 58.3 | 57.0 | 55.4 | 55.5 | 60.1 | 63.8 | 64.8 | 63.1 | 61.9 | 59.8 | 60.0 |
| External temperature [°C] | Te | 4.2 | 4.1 | 5.8 | 7.8 | 11.3 | 14.1 | 16.1 | 15.8 | 13.3 | 10.3 | 6.7 | 5.2 |
| External rel. humidity [%] | phi_e | 83.0 | 80.0 | 76.0 | 71.0 | 68.0 | 71.0 | 72.0 | 74.0 | 77.0 | 81.0 | 82.0 | 84.0 |