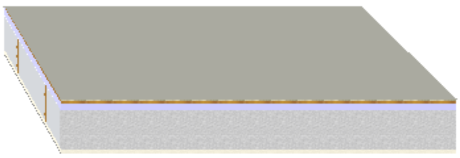
Iconservatories Ltd
T/A Icotherm Solid Roof

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - Pitched roofs**
Component: **Icotherm w/out visqueen**

OUTSIDE

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



INSIDE

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

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m^{2}K/W]
		Rse					0.0400
☑	1	BS EN 12524	Slate [2000 kg/m^3]	0.0050	2.200	D	0.0023
☑	2	BS EN 12524	Bitumen felt/sheet	0.0001	0.230	D	0.0004
☑	3	BS EN 12524	Plywood [300 kg/m^3]	0.0120	0.090	D	0.1333
☑	4	BS EN ISO 6946	Unventilated air layer: 25 mm, upwards heat flow	0.0250	0.156	D	0.1603
☑	5	Inhomogeneous material layer	consisting of:	0.1500	ø 0.030		5.0744
	5a	Ballytherm	PIR Foil Board	93.00 %	0.022	E	-
	5b	BS EN 12524	Softwood Timber [500 kg/m^3]	07.00 %	0.130	D	-
☑	6	British Gypsum Limited	Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	0.0658
☑	7	BS EN 12524	Gypsum plastering	0.0025	0.570	D	0.0044
		Rsi					0.1000
				0.2071			

$R_T = (R_T' + R_T'')/2 = 5.75$ m^{2}K/W

$U = 1/R_T = 0.17$ W/(m^{2}K)

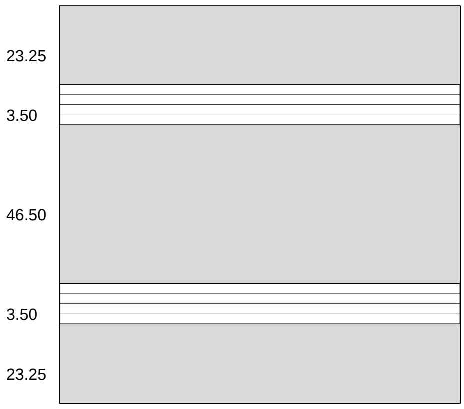
Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
A .. A: Data is entered and validated by the manufacturer or supplier. Data is continuously tested by 3rd party.
B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
C .. C: Data is entered and validated by the manufacturer or supplier.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

U_{max} = **0.20** W/(m^{2}K) U = **0.17** W/(m^{2}K) R_T= **5.75** m^{2}K/W

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

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - Pitched roofs**
Component: **Icotherm w/out visqueen**

Draft of the component (portion in %):



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

A	23.25 + 46.50 + 23.25 consisting of material layers: 1, 2, 3, 4, 5a, 6, 7	= 93.00%
B	3.50 + 3.50 consisting of material layers: 1, 2, 3, 4, 5b, 6, 7	= 7.00%

Upper limit of the thermal transfer resistance R

$$U_A\ [W/(m^2K)] = \frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{7.18 + 0.1 + 0.04} = 0.14$$

$$U_B\ [W/(m^2K)] = \frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{1.52 + 0.1 + 0.04} = 0.60$$

$$R_T' = \frac{1}{A * U_A + B * U_B} = 5.91\ m^2K/W$$

Lower limit of the thermal transfer resistance R

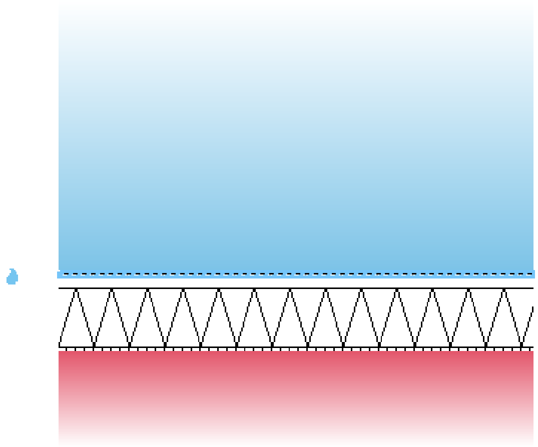
R_{se} [m²K/W]		= 0.04
R_1 " [m²K/W] = d_1 / λ_1 =	0.0050 / 2.200	= 0.00
R_2 " [m²K/W] = d_2 / λ_2 =	0.0001 / 0.230	= 0.00
R_3 " [m²K/W] = d_3 / λ_3 =	0.0120 / 0.090	= 0.13
R_4 " [m²K/W] = d_4 / λ_4 =	0.0250 / 0.156	= 0.16
R_5 " [m²K/W] = $d_5 / (\lambda_{5a} * A + \lambda_{5b} * B)$ =	0.1500 /(0.022 * 93.00% + 0.130 * 7.00%)	= 5.07
R_6 " [m²K/W] = d_6 / λ_6 =	0.0125 / 0.190	= 0.07
R_7 " [m²K/W] = d_7 / λ_7 =	0.0025 / 0.570	= 0.00
R_{si} [m²K/W]		= 0.1

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 5.58\ m^2K/W$$

Iconservatories Ltd
T/A Icotherm Solid Roof

Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - Pitched roofs**
Component: **Icotherm w/out visqueen**

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]
Slate [2000 kg/m³]	0.0050	2.200	D	800.00	D	4.00	0.0023
Bitumen felt/sheet	0.0001	0.230	D	50000.00	D	5.00	0.0004
Plywood [300 kg/m³]	0.0120	0.090	D	60.00	D	0.72	0.1333
Unventilated air layer: 25 mm, upwards heat flow	0.0250	0.156	D	1.00	D	0.03	0.1603
PIR Foil Board	0.1500	0.022	E	60.00	E	9.00	6.8182
Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	970.00	D	12.13	0.0658
Gypsum plastering	0.0025	0.570	D	6.00	D	0.02	0.0044

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.
B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
C .. C: Data is entered and validated by the manufacturer or supplier.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

Source: **own catalogue - Pitched roofs**
Component: **Icotherm w/out visqueen**

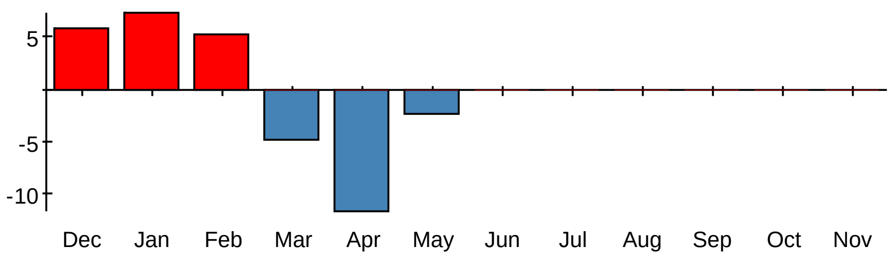
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

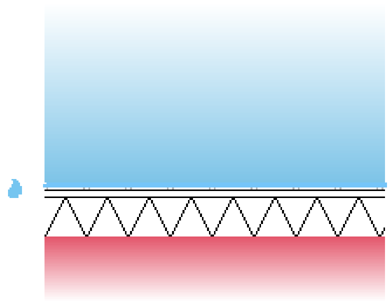
Surface temperature to avoid critical surface moisture:
No danger of mould growth is expected.

Interstitial condensation occurs, but all the condensate is predicted to evaporate during the summer months.

The risk of degradation of building materials and deterioration of thermal performance as a consequence of the calculated maximum amount of moisture shall be considered according to regulatory requirements and other guidance in product standards.

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: Tees-side; 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	3.7	0.850	20.0	0.600	676	726	1403	1753	15.4	0.720	19.5	3.8
	February	4.1	0.840	20.0	0.597	688	708	1396	1745	15.4	0.709	19.5	4.2
	March	6.3	0.760	20.0	0.571	725	610	1336	1669	14.7	0.612	19.5	6.4
	April	7.9	0.720	20.0	0.559	767	539	1306	1632	14.3	0.531	19.6	8.0
	May	11.4	0.700	20.0	0.568	943	383	1326	1658	14.6	0.369	19.7	11.4
	June	14.4	0.710	20.0	0.605	1164	249	1414	1767	15.6	0.208	19.8	14.4
	July	16.6	0.690	20.0	0.622	1303	151	1454	1818	16.0	-0.175	19.9	16.6
	August	16.1	0.710	20.0	0.630	1299	174	1472	1840	16.2	0.025	19.9	16.1
	September	13.8	0.730	20.0	0.611	1151	276	1428	1784	15.7	0.309	19.8	13.8
	October	10.7	0.800	20.0	0.618	1029	414	1443	1804	15.9	0.558	19.7	10.7
	November	6.9	0.820	20.0	0.599	815	584	1399	1749	15.4	0.649	19.6	7.0
	December	4.9	0.860	20.0	0.606	745	673	1417	1772	15.6	0.709	19.5	5.0

- The critical month is January with $f_{Rsi,max}$ = 0.720
  f_{Rsi} = 0.967

$f_{Rsi} > f_{Rsi,max}$, 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 ϕ_{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

Interstitial condensation occurs but all the condensate is predicted to evaporate during the summer months.

The risk of degradation of building materials and deterioration of thermal performance as a consequence of the calculated maximum amount of moisture shall be considered according requirements and other guidance in product standards.

Climcatic conditions
Location: Tees-side; 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	60.0	59.7	57.1	55.9	56.8	60.5	62.2	63.0	61.1	61.8	59.9	60.6
External temperature [°C]	Te	3.7	4.1	6.3	7.9	11.4	14.4	16.6	16.1	13.8	10.7	6.9	4.9
External rel. humidity [%]	phi_e	85.0	84.0	76.0	72.0	70.0	71.0	69.0	71.0	73.0	80.0	82.0	86.0

Monthly moisture content per area gc [g/m²]
Accumulated moisture content per area Ma [g/m²]

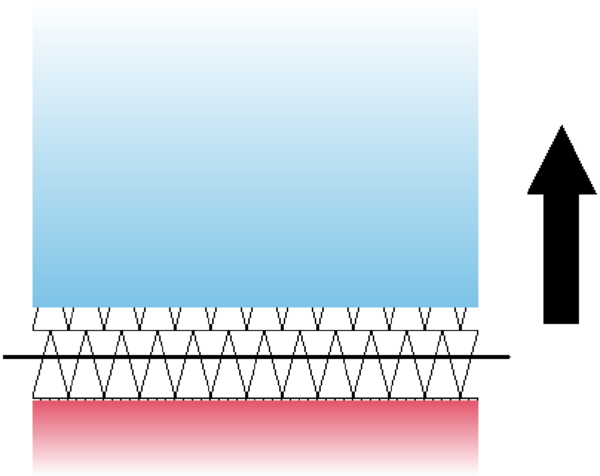
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Bitumen felt/sheet / Plywood [300 kg/m³]	gc	5	5	4	-2	-10	-2	---	---	---	---	---	---
	Ma	5	10	13	12	2	---	---	---	---	---	---	---
Plywood [300 kg/m³] / Unventilated air layer: 25 mm, upwards heat flow	gc	1	2	2	-3	-2	---	---	---	---	---	---	---
	Ma	1	4	5	2	---	---	---	---	---	---	---	---

icotherm solid roof

Iconservatories Ltd
T/A Icotherm Solid Roof

Documentation of the component
Heat capacity
Source: **own catalogue - Pitched roofs**
Component: **Icotherm w/out visqueen**

OUTSIDE



INSIDE

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

Single material layers shown in the U-value calculation printout may be separated to meet the exclusion criteria:

A .. The total thickness of the layers exceed 0.1 m.
B .. The mid point in the construction is reached.

For insulation layers the following criteria applies:

C .. An insulating layer is reached (defined as lambda <= 0.08 W/(mK)).

	Name	Thickness [m]	lambda [W/(mK)]	Q	Thermal capacity [kJ/(kgK)]	Q	Density [kg/m³]	Q	Thermal mass kJ/(m²K)	Criteria Exclusion
	End of calculation - Cold									
1	Slate [2000 kg/m³]	0.0050	2.200	D	1.00	D	2000.0	D	~~10.0~~	A, -, C
2	Bitumen felt/sheet	0.0001	0.230	D	1.00	D	1100.0	D	~~0.1~~	A, -, C
3	Plywood [300 kg/m³]	0.0120	0.090	D	1.60	D	300.0	D	~~5.8~~	A, -, C
4	Unventilated air layer: 25 mm, upwards heat flow	0.0250	0.156	D	1.01	D	1.2	D	~~0.0~~	A, -, C
5	Inhomogeneous material layer consisting of:	0.0650							~~3.6~~	A, -, C
5a	PIR Foil Board	93.00%	0.022	E	1.40	E	30.0	E	~~2.5~~	A, -, C
5b	Softwood Timber [500 kg/m³]	07.00%	0.130	D	1.60	D	500.0	D	~~3.6~~	A, -, C
5	Inhomogeneous material layer consisting of:	0.0850							4.8	-, -, -
5a	PIR Foil Board	93.00%	0.022	E	1.40	E	30.0	E	~~3.3~~	-, -, C
5b	Softwood Timber [500 kg/m³]	07.00%	0.130	D	1.60	D	500.0	D	4.8	-, -, -
6	Gyproc Wallboard DUPLEX 12.5mm	0.0125	0.190	D	1.00	D	684.0	D	8.6	-, -, -
7	Gypsum plastering	0.0025	0.570	D	1.00	D	1300.0	D	3.3	-, -, -
	Start of calculation - Warm									
		0.2071							**16.6**	

Heat capacity = 16.6 kJ/(m²K)

The following exclusion criteria apply:
A .. The total thickness of the layers exceed 0.1 m.
C .. An insulating layer is reached (defined as lambda <= 0.08 W/(mK)).

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.
B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
C .. C: Data is entered and validated by the manufacturer or supplier.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.