BuildDesk U 3.4

Documentation of the component — 2. November 2011
Thermal transmittance (U-value) according to BS EN ISO 6946 —

Source: **Own Catalogue - Pitched roofs**
Component: **R_PB_SIP175_Tile**

OUTSIDE

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

INSIDE

Assignment: Pitched roof < 70°, with integral insulation

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.0400
☑	1	BS EN 12524	Tiles (roofing), concrete	0.0150	1.500	D	0.0100
☑	2	Inhomogeneous material layer	consisting of:	0.0250	ø 0.295		0.0848
	2a	BS EN ISO 6946	Slightly vent. air layer: 25 mm, upwards heat flow	90.00 %	0.313	D	-
	2b	BS EN 12524	Softwood Timber [500 kg/m³]	10.00 %	0.130	D	-
☑	3	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	4	Elastogran	PU Foam 153	0.1450	0.023	E	6.3043
☑	5	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	6	Generic Building Materials	Acoustic or fire resistant plasterboard	0.0125	0.250	D	0.0500
☑	7	Generic Building Materials	Acoustic or fire resistant plasterboard	0.0125	0.250	D	0.0500
		Rsi					0.1000
				0.2320			

$R_T = (R_T' + R_T'')/2 = 6.81$ m²K/W

$U = 1/R_T = 0.15$ W/(m²K)

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
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U_{max} = 0.25 W/(m²K) U = 0.15 W/(m²K) R_T = 6.81 m²K/W

Source of Umax value: England, Wales: Approved Document L1A (2006), Table 2 - New Build Dwellings

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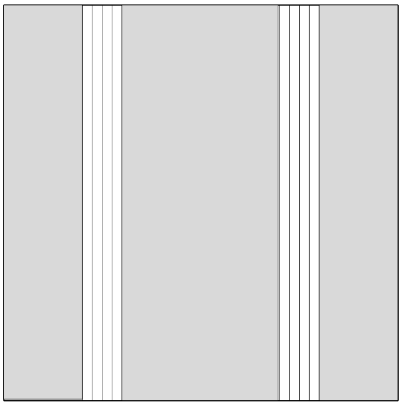
Component: **R_PB_SIP175_Tile**

Draft of the component (portion in %):



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

A	22.50 + 45.00 + 22.50 consisting of material layers: 1, 2a, 3, 4, 5, 6, 7	= 90.00%
B	5.00 + 5.00 consisting of material layers: 1, 2b, 3, 4, 5, 6, 7	= 10.00%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{6.66 + 0.1 + 0.04}$ = 0.15

U_B [W/(m²K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{6.78 + 0.1 + 0.04}$ = 0.14

$$R_T' = \frac{1}{A * U_A + B * U_B} = 6.81\ m^2K/W$$

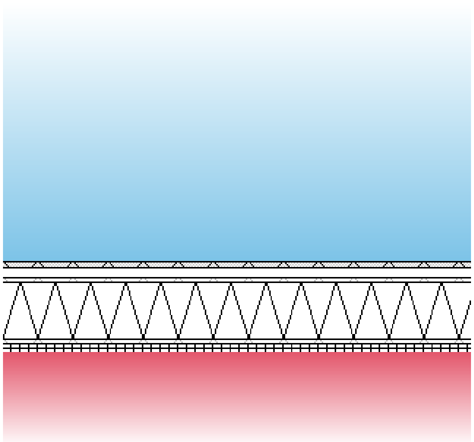
Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]		= 0.04
R_1'' [m²K/W] = d_1 / λ_1 =	0.0150 / 1.500	= 0.01
R_2'' [m²K/W] = $d_2 / (\lambda_{2a} * A + \lambda_{2b} * B)$ =	0.0250 /(0.313 * 90.00% + 0.130 * 10.00%)	= 0.08
R_3'' [m²K/W] = d_3 / λ_3 =	0.0110 / 0.130	= 0.08
R_4'' [m²K/W] = d_4 / λ_4 =	0.1450 / 0.023	= 6.30
R_5'' [m²K/W] = d_5 / λ_5 =	0.0110 / 0.130	= 0.08
R_6'' [m²K/W] = d_6 / λ_6 =	0.0125 / 0.250	= 0.05
R_7'' [m²K/W] = d_7 / λ_7 =	0.0125 / 0.250	= 0.05
R_{si} [m²K/W]		= 0.1

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 6.81\ m^2K/W$$

Documentation of the component
Calculation according BS EN ISO 13788
Source: **Own Catalogue - Pitched roofs**
Component: **R_PB_SIP175_Tile**

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 integral insulation

Name	Thickn. [m]	lambda [W/(mK)]	Q	μ [-]	Q	sd [m]	R [m²K/W]
Tiles (roofing), concrete	0.0150	1.500	D	60.00	D	0.90	0.0100
Slightly vent. air layer: 25 mm, upwards heat flow	0.0250	0.313	D	1.00	D	0.03	0.0799
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
PU Foam 153	0.1450	0.023	E	50.00	E	7.25	6.3043
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
Acoustic or fire resistant plasterboard	0.0125	0.250	D	4.00	D	0.05	0.0500
Acoustic or fire resistant plasterboard	0.0125	0.250	D	4.00	D	0.05	0.0500

Q .. The physical values of the building materials has been graded by their level of quality. These 5 levels are the following
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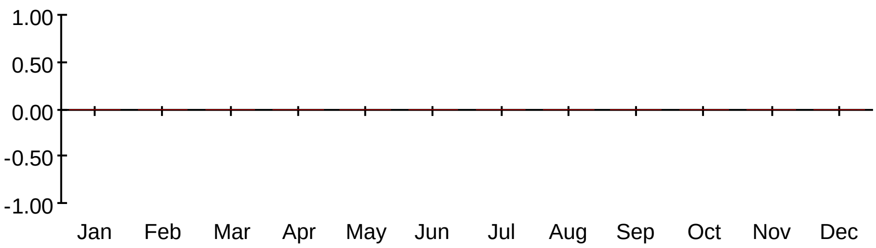
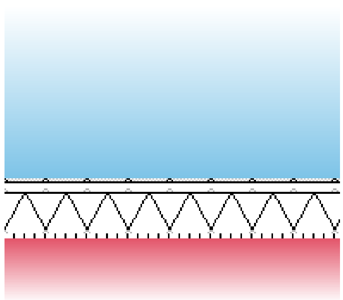
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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).

Source: **Own Catalogue - Pitched roofs**
Component: **R_PB_SIP175_Tile**

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

Location: Stanstead; 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	0.870	20.0	0.607	692	726	1419	1773	15.6	0.731	19.4	3.8
	February	3.5	0.850	20.0	0.600	667	735	1402	1753	15.4	0.723	19.4	3.6
	March	5.5	0.800	20.0	0.585	722	646	1368	1710	15.1	0.659	19.5	5.6
	April	7.4	0.750	20.0	0.570	772	561	1333	1667	14.7	0.575	19.5	7.5
	May	11.0	0.750	20.0	0.593	984	401	1385	1731	15.2	0.471	19.7	11.1
	June	14.2	0.750	20.0	0.630	1214	258	1472	1840	16.2	0.345	19.8	14.2
	July	16.5	0.730	20.0	0.653	1370	156	1526	1907	16.8	0.073	19.9	16.5
	August	16.3	0.730	20.0	0.649	1352	165	1517	1896	16.7	0.100	19.9	16.3
	September	13.9	0.770	20.0	0.639	1222	272	1494	1868	16.4	0.414	19.8	13.9
	October	10.4	0.840	20.0	0.636	1059	428	1487	1858	16.3	0.620	19.7	10.5
	November	6.5	0.870	20.0	0.618	842	601	1443	1804	15.9	0.695	19.5	6.6
	December	4.9	0.880	20.0	0.614	762	673	1435	1793	15.8	0.721	19.5	5.0

- The critical month is January with $f_{Rsi,max}$ = 0.731
  f_{Rsi} = 0.964

$f_{Rsi} > f_{Rsi,max}$, 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

No condensation is predicted at any interface in any month.

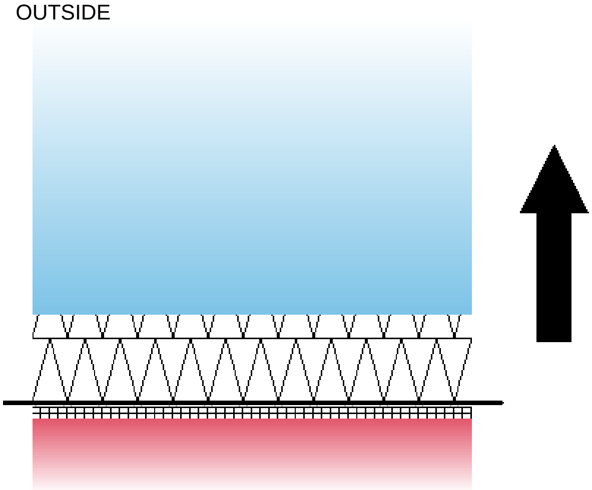
Climcatic conditions
Location: Stanstead; Humidity class according BS EN ISO 13788 annex A: Dwellings with low occupancy

		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	60.7	60.0	58.5	57.0	59.3	63.0	65.3	64.9	63.9	63.6	61.8	61.4
External temperature [°C]	Te	3.7	3.5	5.5	7.4	11.0	14.2	16.5	16.3	13.9	10.4	6.5	4.9
External rel. humidity [%]	phi_e	87.0	85.0	80.0	75.0	75.0	75.0	73.0	73.0	77.0	84.0	87.0	88.0

Documentation of the component | 2. November 2011
Heat capacity |

Source: **Own Catalogue - Pitched roofs**
Component: **R_PB_SIP175_Tile**

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	Tiles (roofing), concrete	0.0150	1.500	D	1.00	D	2100.0	D	~~31.5~~	A, -, C
2	Inhomogeneous material layer consisting of:	0.0250							~~2.0~~	A, -, -
2a	Slightly vent. air layer: 25 mm, upwards heat flow	90.00%	0.313	D	1.01	D	1.2	D	~~0.0~~	A, -, C
2b	Softwood Timber [500 kg/m³]	10.00%	0.130	D	1.60	D	500.0	D	~~2.0~~	A, -, -
3	Oriented strand board (OSB)	0.0110	0.130	D	1.70	D	650.0	D	~~12.2~~	A, -, C
4	PU Foam 153	0.0810	0.023	E	1.70	E	45.0	E	~~0.0~~	A, -, C
4	PU Foam 153	0.0640	0.023	E	1.70	E	45.0	E	~~0.0~~	-, -, C
5	Oriented strand board (OSB)	0.0110	0.130	D	1.70	D	650.0	D	12.2	-, -, -
6	Acoustic or fire resistant plasterboard	0.0125	0.250	D	1.00	D	900.0	D	11.3	-, -, -
7	Acoustic or fire resistant plasterboard	0.0125	0.250	D	1.00	D	900.0	D	11.3	-, -, -
	Start of calculation - Warm									
		0.2320							**34.7**	

Heat capacity = 34.7 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)).

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