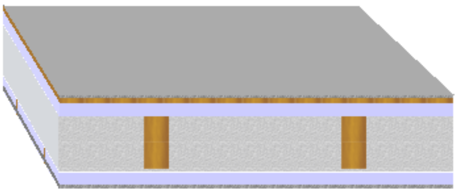
BuildDesk U 3.4

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946

Source: **Airgreen 1**
Component: **Bitumen adh. to PU, on joists, U=0.22W/m²K**

OUTSIDE



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.

INSIDE

Assignment: Flat roof

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.1000
☐	1	BS EN 12524	Bitumen felt/sheet	0.0100	0.230	D	~~0.0435~~
☐	2	BS EN 12524	Plywood [500 kg/m³]	0.0180	0.130	D	~~0.1385~~
☐	3	BS EN ISO 6946	Well ventilated air layer	0.0500	0.000	D	-
☑	4	Inhomogeneous material layer	consisting of:	0.2000	ø 0.046		4.3850
	4a	Libeltex	home iso	87.00 %	0.033	E	-
	4b	BS EN 12524	Softwood Timber [500 kg/m³]	13.00 %	0.130	D	-
☑	5	KdB Ireland	Air-Reflect	0.0120	0.031	E	0.3871
☑	6	Inhomogeneous material layer	consisting of:	0.0500	ø 0.038		1.3214
	6a	kdb insulation	Low E airspace	96.00 %	0.034	E	-
	6b	BS EN 12524	Softwood Timber [500 kg/m³]	04.00 %	0.130	D	-
☑	7	BS EN 12524	Gypsum plasterboard	0.0125	0.250	D	0.0500
		Rsi					0.1000
				0.3525			

☐ was not taken into consideration in the calculation

$R_T = (R_T' + R_T'')/2 = 6.66$ 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
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.
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U = **0.15** W/(m²K) R_T= **6.66** m²K/W

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Thermal transmittance (U-value) according to BS EN ISO 6946
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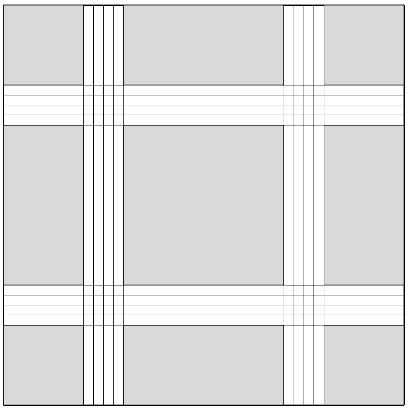
Draft of the component (portion in %):



The intersection of the inhomogeneous layers results in 4 Zones (A, B, C, D). Information given in %.

A	5.22 + 10.44 + 5.22 + 10.44 + 20.88 + 10.44 + 5.22 + 10.44 + 5.22 consisting of material layers: 4a, 5, 6a, 7	= 83.52%
B	1.56 + 3.12 + 1.56 + 1.56 + 3.12 + 1.56 consisting of material layers: 4b, 5, 6a, 7	= 12.48%
C	0.44 + 0.87 + 0.44 + 0.44 + 0.87 + 0.44 consisting of material layers: 4a, 5, 6b, 7	= 3.48%
D	0.13 + 0.13 + 0.13 + 0.13 consisting of material layers: 4b, 5, 6b, 7	= 0.52%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{7.97 + 0.1 + 0.1}$ = 0.12

U_B [W/(m²K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{3.45 + 0.1 + 0.1}$ = 0.27

U_C [W/(m²K)] = $\frac{1}{(\Sigma R_{i,C}) + R_{si} + R_{se}} = \frac{1}{6.88 + 0.1 + 0.1}$ = 0.14

U_D [W/(m²K)] = $\frac{1}{(\Sigma R_{i,D}) + R_{si} + R_{se}} = \frac{1}{2.36 + 0.1 + 0.1}$ = 0.39

$$R_T' = \frac{1}{A * U_A + B * U_B + C * U_C + D * U_D} = 6.97 \text{ m}^2\text{K/W}$$

Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]			= 0.1
R_4" [m²K/W]	$= d_4 / (\lambda_{4a} * (A + C) + \lambda_{4b} * (B + D)) =$	0.2000 /(0.033 * 87.00% + 0.130 * 13.00%)	= 4.39
R_5" [m²K/W]	$= d_5 / \lambda_5 =$	0.0120 / 0.031	= 0.39
R_6" [m²K/W]	$= d_6 / (\lambda_{6a} * (A + B) + \lambda_{6b} * (C + D)) =$	0.0500 /(0.034 * 96.00% + 0.130 * 4.00%)	= 1.32
R_7" [m²K/W]	$= d_7 / \lambda_7 =$	0.0125 / 0.250	= 0.05
R_{si} [m²K/W]			= 0.1

$$R_T" = \Sigma R_i" + R_{si} + R_{se} = 6.34 \text{ m}^2\text{K/W}$$

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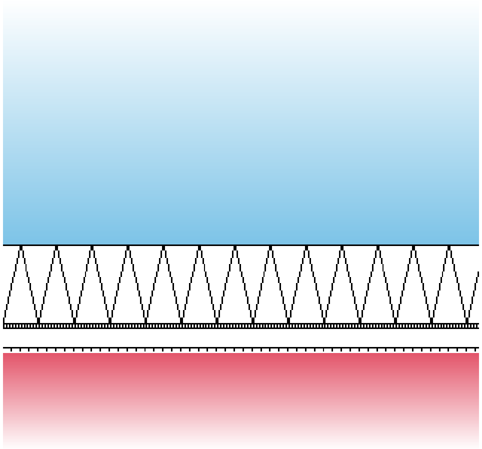
Component: **Bitumen adh. to PU, on joists, U=0.22W/m²K**

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 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. For further information the user is advised to follow the guidance in BS 5250:2021 Management of moisture in buildings

Assignment: Flat roof

Name	Thickn. [m]	lambda [W/(mK)]	Q	µ [-]	Q	sd [m]	R [m²K/W]
home iso	0.2000	0.033	E	1.00	E	0.20	6.0606
Air-Reflect	0.0120	0.031	E	29231.00	E	350.77	0.3871
Low E airspace	0.0500	0.034	E	1.00	E	0.05	1.4706
Gypsum 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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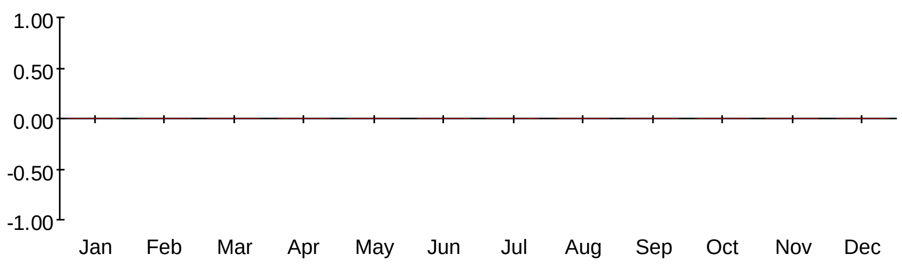
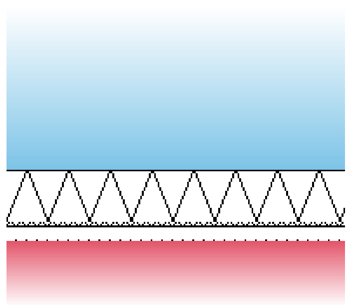
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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

Condensation Risk Analysis calculations according to BS EN ISO 13788 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. For further information the user is advised to follow the prescriptive guidance in BS 5250:2021 Management of moisture in buildings – Code of practice & BRE Information Paper:IP2/O5 (Feb. 2005) 'Modelling and controlling interstitial condensation

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

Location: Mullingar; Humidity class according BS EN ISO 13788 annex A: 3 Buildings with unknown occupancy; Return period according BS 5250:2021 Once in 10 years (-1°C Ext Temp, +4% Ext RH)

		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	1.3	0.930	20.0	0.594	536	852	1388	1735	15.3	0.772	19.4	-0.6
	February	1.4	0.900	20.0	0.586	523	845	1368	1710	15.1	0.760	19.4	-0.5
	March	2.9	0.880	20.0	0.586	573	795	1369	1711	15.1	0.741	19.4	1.0
	April	4.5	0.840	20.0	0.581	614	743	1357	1697	14.9	0.710	19.5	2.6
	May	7.2	0.830	20.0	0.598	734	663	1397	1746	15.4	0.688	19.6	5.3
	June	10.1	0.840	20.0	0.637	907	583	1489	1862	16.4	0.696	19.6	8.2
	July	11.9	0.850	20.0	0.672	1036	535	1571	1964	17.2	0.725	19.7	9.9
	August	11.3	0.870	20.0	0.673	1019	555	1573	1967	17.2	0.742	19.7	9.4
	September	9.1	0.890	20.0	0.648	897	618	1515	1894	16.6	0.740	19.6	7.2
	October	6.3	0.910	20.0	0.622	755	699	1455	1818	16.0	0.746	19.5	4.4
	November	3.4	0.930	20.0	0.605	628	786	1414	1767	15.6	0.762	19.4	1.5
	December	2.3	0.940	20.0	0.602	587	819	1406	1757	15.5	0.770	19.4	0.4

- The critical month is January with $f_{Rsi,max}$ = 0.772
  f_{Rsi} = 0.970

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

Climatic conditions
Location: Mullingar; Humidity class according BS EN ISO 13788 annex A: 3 Buildings with unknown occupancy; Return period according BS 5250:2021 Once in 10 years (-1°C Ext Temp, +4% Ext RH)

		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	58.6	58.6	58.1	59.8	63.7	67.2	67.3	64.8	62.2	60.5	60.2
External temperature [°C]	Te	1.3	1.4	2.9	4.5	7.2	10.1	11.9	11.3	9.1	6.3	3.4	2.3
External rel. humidity [%]	phi_e	93.0	90.0	88.0	84.0	83.0	84.0	85.0	87.0	89.0	91.0	93.0	94.0

Documentation of the component
Heat capacity

Source: **Airgreen 1**
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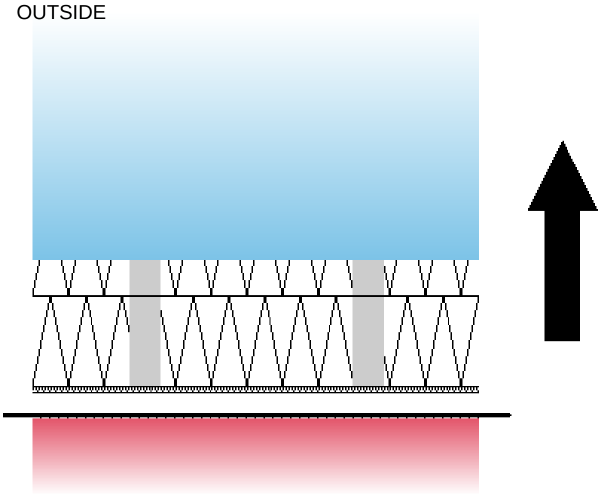
OUTSIDE



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	Bitumen felt/sheet	0.0100	0.230	D	1.00	D	1100.0	D	~~11.0~~	A, -, C
2	Plywood [500 kg/m³]	0.0180	0.130	D	1.60	D	500.0	D	~~14.4~~	A, -, C
3	Well ventilated air layer	0.0500	0.000	D	1.01	D	1.2	D	~~0.0~~	A, -, C
4	Inhomogeneous material layer consisting of:	0.1745							~~18.1~~	A, -, C
4a	home iso	87.00%	0.033	E	0.48	E	10.2	E	~~0.7~~	A, -, C
4b	Softwood Timber [500 kg/m³]	13.00%	0.130	D	1.60	D	500.0	D	~~18.1~~	A, -, C
4	Inhomogeneous material layer consisting of:	0.0255							~~2.7~~	-, -, C
4a	home iso	87.00%	0.033	E	0.48	E	10.2	E	~~0.1~~	-, -, C
4b	Softwood Timber [500 kg/m³]	13.00%	0.130	D	1.60	D	500.0	D	~~2.7~~	-, -, C
5	Air-Reflect	0.0120	0.031	E	0.88	E	57.6	E	~~0.0~~	-, -, C
6	Inhomogeneous material layer consisting of:	0.0500							~~1.6~~	-, -, C
6a	Low E airspace	96.00%	0.034	E	1.01	E	1.2	E	~~0.1~~	-, -, C
6b	Softwood Timber [500 kg/m³]	04.00%	0.130	D	1.60	D	500.0	D	1.6	-, -, -
7	Gypsum plasterboard	0.0125	0.250	D	1.00	D	900.0	D	11.3	-, -, -
	Start of calculation - Warm									
		0.3525							**11.3**	

Heat capacity = 11.3 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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