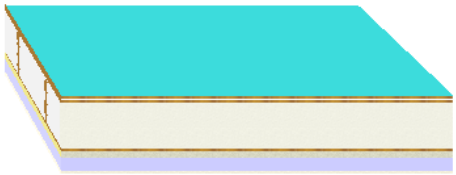
sip panels by future rooms

Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - Future SIPs roof systems**
Component: **Future SIPs Roof - 175mm eps and 25mm PIR**

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 [m²K/W]
		Rse					0.0400
☑	1	BS EN 12524	Breather membrane	0.0001	0.170	D	0.0006
☑	2	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	3	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	4	Inhomogeneous material layer	consisting of:	0.1750	ø 0.040		4.3849
	4a	Lambdatherm Grey EPS Air gaps	Expanded polystyrene (EPS) - Variable thickness Level 0: dU'' = 0.00 W/(m²K)	91.00 %	0.031	E	-
	4b	BS EN 12524	Softwood Timber [500 kg/m³]	09.00 %	0.130	D	-
☑	5	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	6	Generic Building Materials Air gaps	Polyisocyanurate (PIR) - General Purpose Level 1: dU'' = 0.01 W/(m²K)	0.0250	0.020	D	1.2500
☑	7	Visqueen Building Products	Visqueen Vapour Barrier	0.0001	0.330	D	0.0004
☑	8	BS EN ISO 6946	Unventilated air layer: 50 mm, upwards heat flow	0.0500	0.313	D	0.1597
☑	9	Knauf Drywall	Knauf Wallboard	0.0095	0.160	D	0.0594
		Rsi					0.1000
				0.2927			

$R_T = (R_T' + R_T'')/2 = 6.48$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Air gaps	BS EN ISO 6946 Annex F	~~0.0004~~
Air gaps and fixings corrections need not be applied, as their total effect is less than 3% (Annex D BS 6946:1996).		
		0.0000

$U = 1/R_T + \Sigma\Delta U = 0.15$ 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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B .. B: Data is entered and validated by the manufacturer or supplier. Data is certified by 3rd party
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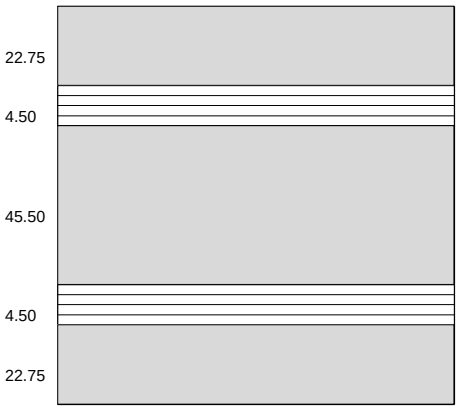
E .. E: Information is entered by the user of the BuildDesk software without special agreement with the manufacturer, supplier or others.

U_{max} = 0.18 W/(m²K) U = 0.15 W/(m²K) R_T= 6.48 m²K/W

Source of Umax value: England and Wales Approved Document L1B 2010 Tab 1 Dwellings Existing New Thermal Elements

Documentation of the component — 16. September 2022
Thermal transmittance (U-value) according to BS EN ISO 6946 — Page 2/7
Source: **own catalogue - Future SIPs roof systems**
Component: **Future SIPs Roof - 175mm eps and 25mm PIR**

Draft of the component (portion in %):



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

A	22.75 + 45.50 + 22.75 consisting of material layers: 1, 2, 3, 4a, 5, 6, 7, 8, 9	= 91.00%
B	4.50 + 4.50 consisting of material layers: 1, 2, 3, 4b, 5, 6, 7, 8, 9	= 9.00%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}}$ = $\frac{1}{7.37 + 0.1 + 0.04}$ = 0.13

U_B [W/(m²K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}}$ = $\frac{1}{3.07 + 0.1 + 0.04}$ = 0.31

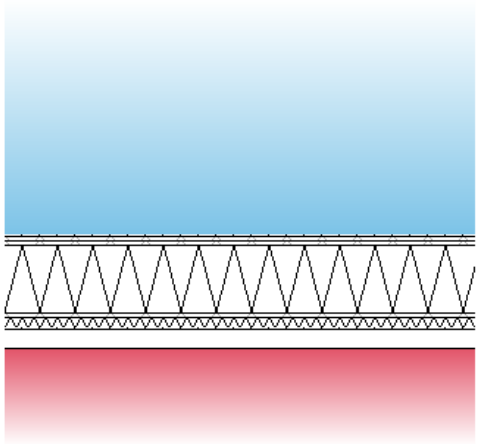
$$R_T' = \frac{1}{A * U_A + B * U_B} = 6.70\ m^2K/W$$

Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]		= 0.04
R_1'' [m²K/W] = d_1/λ_1 =	0.0001 / 0.170	= 0.00
R_2'' [m²K/W] = d_2/λ_2 =	0.0110 / 0.130	= 0.08
R_3'' [m²K/W] = d_3/λ_3 =	0.0110 / 0.130	= 0.08
R_4'' [m²K/W] = $d_4/(\lambda_{4a} * A + \lambda_{4b} * B)$ =	0.1750 /(0.031 * 91.00% + 0.130 * 9.00%)	= 4.38
R_5'' [m²K/W] = d_5/λ_5 =	0.0110 / 0.130	= 0.08
R_6'' [m²K/W] = d_6/λ_6 =	0.0250 / 0.020	= 1.25
R_7'' [m²K/W] = d_7/λ_7 =	0.0001 / 0.330	= 0.00
R_8'' [m²K/W] = d_8/λ_8 =	0.0500 / 0.313	= 0.16
R_9'' [m²K/W] = d_9/λ_9 =	0.0095 / 0.160	= 0.06
R_{si} [m²K/W]		= 0.1

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 6.25\ m^2K/W$$

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

The CRA calculation for pitched roofs may prove unreliable if other factors, such as air leakage into the structure occurs and caution should be used when interpreting these results. For further information the user is advised to follow the guidance in BS 5250:2021 Management of moisture in buildings – Code of practice

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

Name	Thickn. [m]	lambda [W/(mK)]	Q	μ [-]	Q	sd [m]	R [m²K/W]
Breather membrane	0.0001	0.170	D	2000.00	D	0.20	0.0006
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
Expanded polystyrene (EPS) - Variable thickness	0.1750	0.031	E	20.00	E	3.50	5.6452
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
Polyisocyanurate (PIR) - General Purpose	0.0250	0.020	D	50.00	D	1.25	1.2500
Visqueen Vapour Barrier	0.0001	0.330	D	333333.0 0	D	40.00	0.0004
Unventilated air layer: 50 mm, upwards heat flow	0.0500	0.313	D	1.00	D	0.05	0.1597
Knauf Wallboard	0.0095	0.160	D	4.00	D	0.04	0.0594

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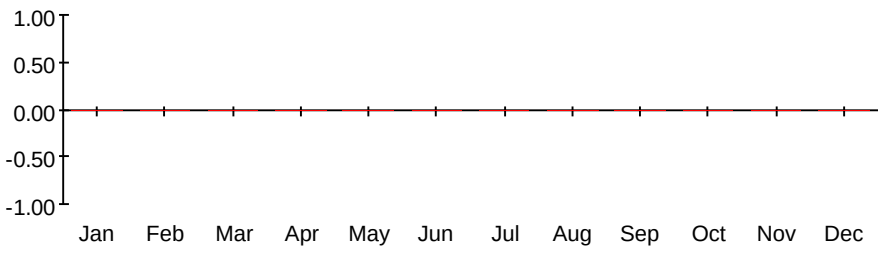
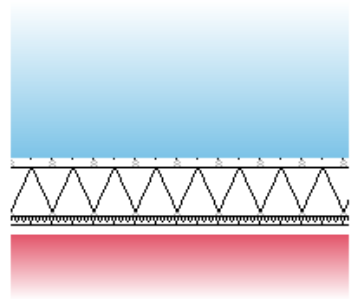
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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

The CRA calculation for pitched roofs may prove unreliable if other factors, such as air leakage into the structure occurs and caution should be used when interpreting these results. For further information the user is advised to follow the guidance in BS 5250:2021 Management of moisture in buildings – Code of practice

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

Location: Birmingham; Humidity class according BS EN ISO 13788 annex A: legacy; Dwellings with low occupancy; Return period according BS 5250:2021 No Corrections

		1	2	3	4	5	6	7	8	9	10	11	12
	Month	Te [°C]	phi_e ---	Ti [°C]	phi_i ---	pe [Pa]	delta p [Pa]	pi [Pa]	ps(Tsi) [Pa]	Tsi,min [°C]	fRsi ---	Tsi [°C]	Tse [°C]
I	January	1.9	0.840	20.0	0.597	509	886	1395	1743	15.4	0.769	19.3	0.0
	February	1.7	0.830	20.0	0.594	494	894	1388	1735	15.3	0.767	19.3	-0.2
	March	3.8	0.780	20.0	0.576	542	805	1347	1684	14.8	0.715	19.4	1.9
	April	5.6	0.730	20.0	0.558	577	728	1305	1631	14.3	0.654	19.5	3.7
	May	9.0	0.720	20.0	0.563	721	595	1316	1645	14.5	0.573	19.6	7.1
	June	12.1	0.720	20.0	0.585	890	478	1368	1710	15.0	0.500	19.7	10.2
	July	14.3	0.710	20.0	0.604	1015	395	1411	1763	15.5	0.419	19.7	12.3
	August	13.9	0.720	20.0	0.605	1003	412	1415	1768	15.6	0.454	19.7	11.9
	September	11.3	0.770	20.0	0.607	902	517	1418	1773	15.6	0.590	19.7	9.4
	October	7.8	0.820	20.0	0.604	756	655	1411	1764	15.5	0.685	19.5	5.9
	November	4.4	0.840	20.0	0.598	610	788	1397	1747	15.4	0.737	19.4	2.5
	December	2.9	0.850	20.0	0.600	554	847	1401	1751	15.4	0.760	19.4	1.0

- The critical month is January with $f_{Rsi,max}$ = 0.769
  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 $T_{se} = T_e + R_{se} * U * (T_i - T_e)$

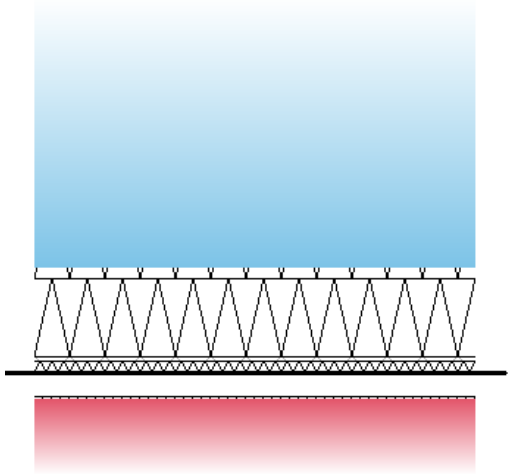
Interstitial condensation - main results
Calculation according BS EN ISO 13788

No condensation is predicted at any interface in any month.

Climatic conditions
Location: Birmingham; Humidity class according BS EN ISO 13788 annex A: legacy; Dwellings with low occupancy; Return period according BS 5250:2021 No Corrections

		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	59.7	59.4	57.6	55.8	56.3	58.5	60.4	60.5	60.7	60.4	59.8	60.0
External temperature [°C]	Te	1.9	1.7	3.8	5.6	9.0	12.1	14.3	13.9	11.3	7.8	4.4	2.9
External rel. humidity [%]	phi_e	84.0	83.0	78.0	73.0	72.0	72.0	71.0	72.0	77.0	82.0	84.0	85.0

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	Breather membrane	0.0001	0.170	D	1.80	D	350.0	D	~~0.1~~	A, -, C
2	Oriented strand board (OSB)	0.0110	0.130	D	1.70	D	650.0	D	~~12.2~~	A, -, C
3	Oriented strand board (OSB)	0.0110	0.130	D	1.70	D	650.0	D	~~12.2~~	A, -, C
4	Inhomogeneous material layer consisting of:	0.1706							~~12.3~~	A, -, C
4a	Expanded polystyrene (EPS) - Variable thickness	91.00%	0.031	E	1.45	E	15.0	E	~~3.4~~	A, -, C
4b	Softwood Timber [500 kg/m³]	09.00%	0.130	D	1.60	D	500.0	D	~~12.3~~	A, -, -
4	Inhomogeneous material layer consisting of:	0.0044							~~0.3~~	-, -, C
4a	Expanded polystyrene (EPS) - Variable thickness	91.00%	0.031	E	1.45	E	15.0	E	~~0.1~~	-, -, C
4b	Softwood Timber [500 kg/m³]	09.00%	0.130	D	1.60	D	500.0	D	0.3	-, -, -
5	Oriented strand board (OSB)	0.0110	0.130	D	1.70	D	650.0	D	~~12.2~~	-, -, C
6	Polyisocyanurate (PIR) - General Purpose	0.0250	0.020	D	0.92	D	32.0	D	~~0.0~~	-, -, C
7	Visqueen Vapour Barrier	0.0001	0.330	D	2.20	D	920.0	D	0.2	-, -, -
8	Unventilated air layer: 50 mm, upwards heat flow	0.0500	0.313	D	1.01	D	1.2	D	0.1	-, -, -
9	Knauf Wallboard	0.0095	0.160	D	1.00	D	650.0	D	6.2	-, -, -
	Start of calculation - Warm									
		0.2927							**6.5**	

Heat capacity = 6.5 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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