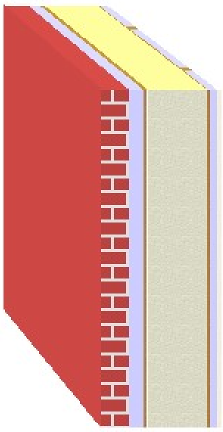
Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **Own Catalogue - Reflective Membrane & VCL**
Component: **Brick-TF200-SIP-VC foil-FR30**

OUTSIDE INSIDE



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

Assignment: External wall

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.0400
☑	1	Generic Building Materials	Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregard acc. BRE 443)	0.1020	0.770	D	0.1325
☑	2	Own catalogue	TF200 Unvent. air layer: 50 mm	0.0500	0.065	E	0.7692
☑	3	BS EN 12524	Breather membrane	0.0001	0.170	D	0.0006
☑	4	BS EN 12524	Oriented strand board (OSB)	0.0120	0.130	D	0.0923
☑	5	SBS	SBS 120+	0.2010	0.028	E	7.1786
		Air gaps	Level 0: dU" = 0.00 W/(m²K)				
☑	6	BS EN 12524	Oriented strand board (OSB)	0.0120	0.130	D	0.0923
☑	7	Own catalogue	VC Foil Ultra	0.0005	200.000	E	0.0000
☑	8	Inhomogeneous material layer	consisting of:	0.0250	ø 0.036		0.6884
	8a	Protect	VC Foil Unvent. air layer: 25 mm	92.00 %	0.028	E	-
	8b	BS EN 12524	Softwood Timber [500 kg/m³]	08.00 %	0.130	D	-
☑	9	British Gypsum Limited	Gyproc FireLine	0.0125	0.240	D	0.0521
		Rsi					0.1300
				0.4151			

$R_T = (R_T' + R_T'')/2 = 9.25$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Air gaps	BS EN ISO 6946 Annex F	~~0.0000~~
		0.0000

$U = 1/R_T + \Sigma\Delta U = 0.11$ 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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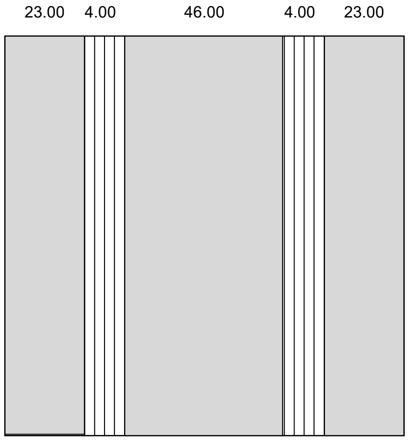
U_{max} = 0.30 W/(m²K) U = 0.11 W/(m²K) R_T= 9.25 m²K/W

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

Draft of the component (portion in %):



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

A	23.00 + 46.00 + 23.00 consisting of material layers: 1, 2, 3, 4, 5, 6, 7, 8a, 9		= 92.00%
B	4.00 + 4.00 consisting of material layers: 1, 2, 3, 4, 5, 6, 7, 8b, 9		= 8.00%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\dfrac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \dfrac{1}{9.21 + 0.13 + 0.04}$ = 0.11

U_B [W/(m²K)] = $\dfrac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \dfrac{1}{8.51 + 0.13 + 0.04}$ = 0.12

$$R_T' = \frac{1}{A * U_A + B * U_B} = 9.32\ m^2K/W$$

Lower limit of the thermal transfer resistance R

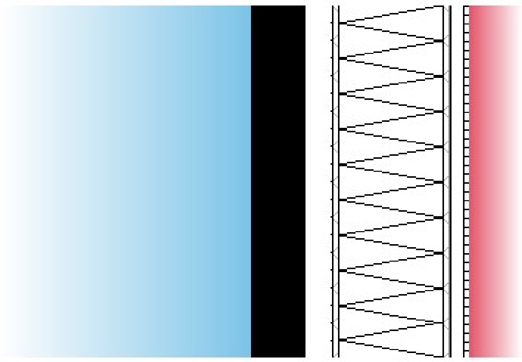
R_{se} [m²K/W]			= 0.04
R_1" [m²K/W]	$= d_1/\lambda_1 =$	0.1020 / 0.770	= 0.13
R_2" [m²K/W]	$= d_2/\lambda_2 =$	0.0500 / 0.065	= 0.77
R_3" [m²K/W]	$= d_3/\lambda_3 =$	0.0001 / 0.170	= 0.00
R_4" [m²K/W]	$= d_4/\lambda_4 =$	0.0120 / 0.130	= 0.09
R_5" [m²K/W]	$= d_5/\lambda_5 =$	0.2010 / 0.028	= 7.18
R_6" [m²K/W]	$= d_6/\lambda_6 =$	0.0120 / 0.130	= 0.09
R_7" [m²K/W]	$= d_7/\lambda_7 =$	0.0005 / 200.000	= 0.00
R_8" [m²K/W]	$= d_8/(\lambda_{8a} * A + \lambda_{8b} * B) =$	0.0250 /(0.028 * 92.00% + 0.130 * 8.00%)	= 0.69
R_9" [m²K/W]	$= d_9/\lambda_9 =$	0.0125 / 0.240	= 0.05
R_{si} [m²K/W]			= 0.13

$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 9.18\ m^2K/W$$

Source: **Own Catalogue - Reflective Membrane & VCL**

Component: **Brick-TF200-SIP-VC foil-FR30**

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: External wall

Name	Thickn. [m]	lambda [W/(mK)]	Q	μ [-]	Q	sd [m]	R [m²K/W]
Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregard acc. BRE 443)	0.1020	0.770	D	45.00	D	4.59	0.1325
TF200 Unvent. air layer: 50 mm	0.0500	0.065	E	150.00	E	7.50	0.7692
Breather membrane	0.0001	0.170	D	2000.00	D	0.20	0.0006
Oriented strand board (OSB)	0.0120	0.130	D	30.00	D	0.36	0.0923
SBS 120+	0.2010	0.028	E	35.00	E	7.04	7.1786
Oriented strand board (OSB)	0.0120	0.130	D	30.00	D	0.36	0.0923
VC Foil Ultra	0.0005	200.000	E	1727083.00	E	829.00	0.0000
VC Foil Unvent. air layer: 25 mm	0.0250	0.028	E	39560.00	E	989.00	0.8875
Gyproc FireLine	0.0125	0.240	D	10.00	D	0.13	0.0521

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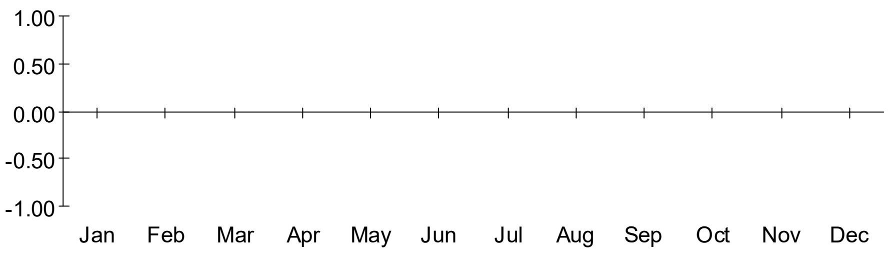
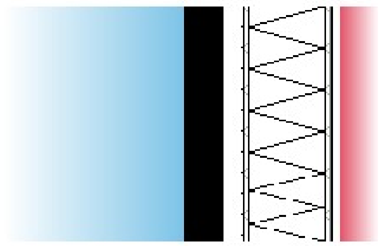
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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: Liverpool; 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]
●	January	3.6	0.880	20.0	0.589	695	682	1378	1722	15.2	0.705	19.6	3.7
	February	3.4	0.870	20.0	0.585	678	689	1367	1709	15.0	0.701	19.6	3.5
	March	5.2	0.830	20.0	0.582	734	625	1359	1699	15.0	0.659	19.6	5.3
	April	7.1	0.780	20.0	0.575	786	558	1344	1680	14.8	0.595	19.7	7.2
	May	10.3	0.760	20.0	0.597	952	444	1396	1745	15.4	0.522	19.7	10.3
	June	13.2	0.790	20.0	0.659	1198	341	1540	1924	16.9	0.544	19.8	13.2
	July	15.2	0.790	20.0	0.699	1364	270	1634	2043	17.8	0.551	19.9	15.2
	August	14.9	0.810	20.0	0.707	1372	281	1653	2066	18.0	0.613	19.9	14.9
	September	12.4	0.830	20.0	0.669	1195	370	1564	1955	17.2	0.625	19.8	12.4
	October	9.1	0.870	20.0	0.638	1005	487	1492	1865	16.4	0.670	19.7	9.1
	November	5.9	0.880	20.0	0.606	817	601	1417	1772	15.6	0.688	19.6	6.0
	December	4.4	0.890	20.0	0.598	744	654	1398	1747	15.4	0.704	19.6	4.5

● The critical month is January with $f_{Rsi,max}$ = 0.705
f_{Rsi} = 0.974

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

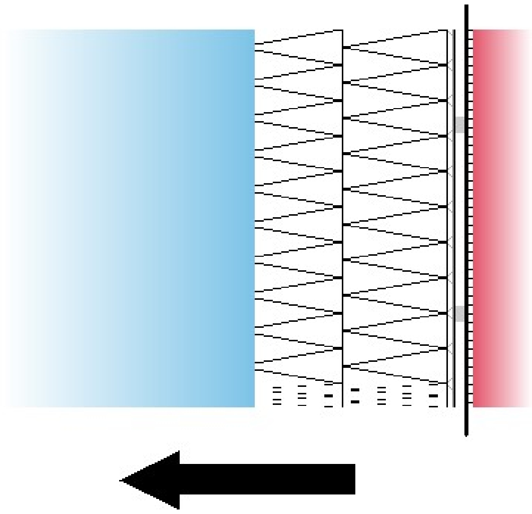
No condensation is predicted at any interface in any month.

Climatic conditions
Location: Liverpool; 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	58.9	58.5	58.2	57.5	59.7	65.9	69.9	70.7	66.9	63.8	60.6	59.8
External temperature [°C]	Te	3.6	3.4	5.2	7.1	10.3	13.2	15.2	14.9	12.4	9.1	5.9	4.4
External rel. humidity [%]	phi_e	88.0	87.0	83.0	78.0	76.0	79.0	79.0	81.0	83.0	87.0	88.0	89.0

Source: **Own Catalogue - Reflective Membrane & VCL**
Component: **Brick-TF200-SIP-VC foil-FR30**

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	Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregard acc. BRE 443)	0.1020	0.770	D	0.80	D	1700.0	D	~~138.7~~	A, -, C
2	TF200 Unvent. air layer: 50 mm	0.0500	0.065	E	1.01	E	1.3	E	~~0.0~~	A, -, C
3	Breather membrane	0.0001	0.170	D	1.80	D	350.0	D	~~0.1~~	A, -, C
4	Oriented strand board (OSB)	0.0120	0.130	D	1.70	D	650.0	D	~~13.3~~	A, -, C
5	SBS 120+	0.1510	0.028	E	1.40	E	44.0	E	~~0.0~~	A, -, C
5	SBS 120+	0.0500	0.028	E	1.40	E	44.0	E	~~0.0~~	-, -, C
6	Oriented strand board (OSB)	0.0120	0.130	D	1.70	D	650.0	D	~~13.3~~	-, -, C
7	VC Foil Ultra	0.0005	200.000	E	0.88	E	1300.0	E	~~0.5~~	-, -, C
8	Inhomogeneous material layer consisting of:	0.0250							~~1.6~~	-, -, C
8a	VC Foil Unvent. air layer: 25 mm	92.00%	0.028	E	1.01	E	375.0	E	~~8.7~~	-, -, C
8b	Softwood Timber [500 kg/m³]	08.00%	0.130	D	1.60	D	500.0	D	1.6	-, -, -
9	Gyproc FireLine	0.0125	0.240	D	1.00	D	780.0	D	9.8	-, -, -
	Start of calculation - Warm									
		0.4151							**9.8**	

Heat capacity = 9.8 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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