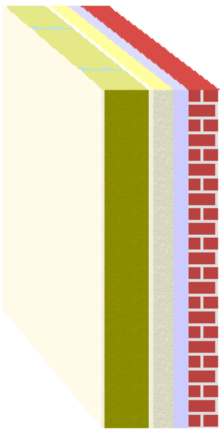
Documentation of the component — 8. October 2015
Thermal transmittance (U-value) according to Digest 465 — Page 1/7
Source: **own catalogue**
Component: **New external wall**

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	British Gypsum Limited	Gyproc Wallboard	0.0150	0.190	D	0.0789
☑	2	Light steel-frame	consisting of:	0.1500	ø 0.125		1.1975
	2a	Generic Building Materials	Mineral wool quilt - Variable thickness	99.83 %	0.042	D	-
		Air gaps	Level 1: dU'' = 0.01 W/(m²K)				
	2b	BS EN 12524	Steel	00.17 %	50.000	D	-
☑	3	Siniat Limited	GTEC Weather Defence 12.5mm	0.0125	0.190	B	0.0658
☑	4	Kingspan Insulation	Kingspan Kooltherm K8 Cavity Board 45-100mm	0.0700	0.022	D	3.1818
		Fixings	Vertical Twist Galvl No./m²:	2.5/m²	50.000	E	-
		Fixings	equivalent diameter: 0.0101 m				
		Air gaps	Level 1: dU'' = 0.01 W/(m²K)				
☑	5	BS EN ISO 6946	Unventilated air layer: 50 mm, horiz. heat flow	0.0500	0.278	D	0.1799
☑	6	Generic Building Materials	Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregarding acc. BRE 4.4.3)	0.1020	0.770	D	0.1325
		Rsi					0.1300
				0.3995			

$R_T = p*R_T' + (1-p)*R_T'' = 6.43$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Mechanical fasteners	Digest 465	0.056
Air gaps	BS EN ISO 6946 Annex D	0.003
		0.059

$U = 1/R_T + \Sigma\Delta U = 0.21$ W/(m²K)

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U_{max} = 0.30 W/(m²K) U = 0.21 W/(m²K) R_T= 6.43 m²K/W

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

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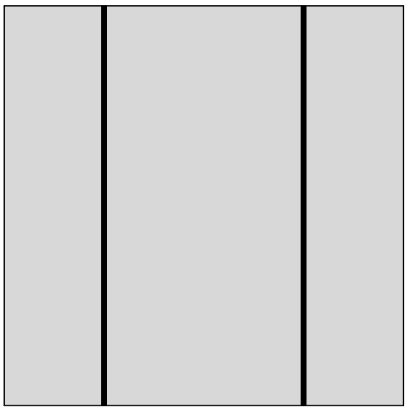
Steel percentage: 0.17 %



Light steel-frame sections
The portion is given in %.

A	consisting of material layers: 1, 2a, 3, 4, 5, 6	= 99.83%
B	consisting of material layers: 1, 2b, 3, 4, 5, 6	= 0.17%

Upper limit of the thermal transfer resistance R

$$U_A\ [W/(m^2K)] = \frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}} = \frac{1}{7.21 + 0.13 + 0.04} = 0.14$$

$$U_B\ [W/(m^2K)] = \frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}} = \frac{1}{3.64 + 0.13 + 0.04} = 0.26$$

$$R_T' = \frac{1}{A * U_A + B * U_B} = 7.37\ m^2K/W$$

Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]		= 0.04
R_1'' [m²K/W] = d_1/λ_1=	0.0150 / 0.190	= 0.08
R_2'' [m²K/W] = $d_2/(\lambda_{2a} * A + \lambda_{2b} * B)$ =	0.1500 /(0.042 * 99.83% + 50.000 * 0.17%)	= 1.20
R_3'' [m²K/W] = d_3/λ_3=	0.0125 / 0.190	= 0.07
R_4'' [m²K/W] = d_4/λ'_4=	0.0700 / 0.022	= 3.18
R_5'' [m²K/W] = d_5/λ_5=	0.0500 / 0.278	= 0.18
R_6'' [m²K/W] = d_6/λ_6=	0.1020 / 0.770	= 0.13
R_{si} [m²K/W]		= 0.13

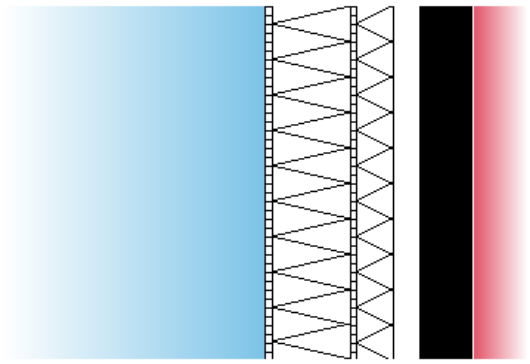
$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 5.01\ m^2K/W$$

Kind of frame:	Cold frame
Flange width:	known not to exceed 50 mm
Stud spacing s [m]:	0.600
Stud depth d [m]:	0.150
Web thickness t [m]:	0.00100
Steel percentage [%]:	0.17

Weight factor p
Formula: $p = 0,8 * (R_T''/R_T') + 0,32 - 0,2 * (0,6/s) - 0,04 * (d/0,1)$ = **0.604**

$$R_T = p*R_T' + (1-p)*R_T'' = 6.43\ m^2K/W$$

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 13788:2002 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.

Assignment: External wall

Name	Thickn. [m]	lambda [W/(mK)]	Q	μ [-]	Q	sd [m]	R [m²K/W]
Gyproc Wallboard	0.0150	0.190	D	10.00	D	0.15	0.0789
Mineral wool quilt - Variable thickness	0.1500	0.042	D	1.00	D	0.15	3.5714
GTEC Weather Defence 12.5mm	0.0125	0.190	B	12.00	B	0.15	0.0658
Kingspan Kooltherm K8 Cavity Board 45-100mm	0.0700	0.022	D	60.00	D	4.20	3.1818
Unventilated air layer: 50 mm, horiz. heat flow	0.0500	0.278	D	1.00	D	0.05	0.1799
Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregarding acc. BRE 4.4.3)	0.1020	0.770	D	45.00	D	4.59	0.1325

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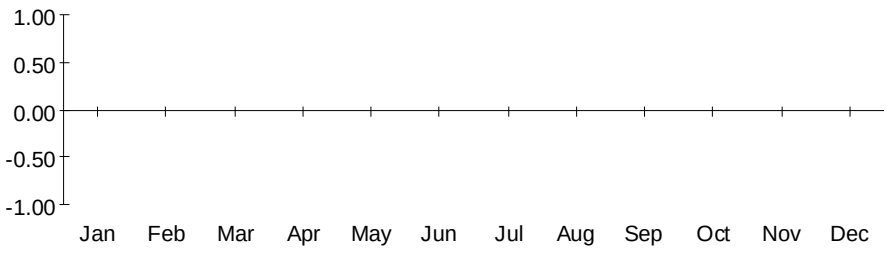
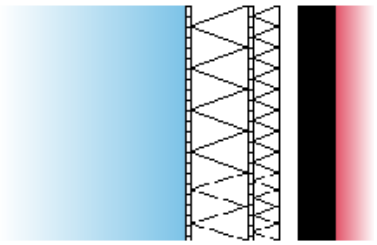
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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.

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

Location: Greenock; 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]
●	January	5.7	0.810	20.0	0.590	741	637	1379	1723	15.2	0.662	19.5	5.8
	February	5.5	0.780	20.0	0.578	704	646	1350	1688	14.8	0.645	19.5	5.6
	March	6.7	0.780	20.0	0.581	765	593	1358	1697	14.9	0.619	19.6	6.8
	April	7.9	0.750	20.0	0.572	799	539	1338	1672	14.7	0.562	19.6	8.0
	May	11.1	0.710	20.0	0.571	938	396	1334	1668	14.7	0.400	19.7	11.1
	June	13.2	0.740	20.0	0.610	1122	303	1425	1782	15.7	0.366	19.8	13.2
	July	14.9	0.760	20.0	0.648	1287	227	1514	1893	16.6	0.341	19.8	14.9
	August	14.4	0.780	20.0	0.654	1279	249	1528	1911	16.8	0.426	19.8	14.4
	September	12.5	0.770	20.0	0.620	1115	334	1450	1812	16.0	0.461	19.8	12.5
	October	9.7	0.810	20.0	0.613	974	459	1433	1791	15.8	0.590	19.7	9.8
	November	7.4	0.800	20.0	0.593	823	561	1385	1731	15.2	0.622	19.6	7.5
	December	6.0	0.810	20.0	0.591	757	624	1381	1726	15.2	0.657	19.5	6.1

- The critical month is January with $f_{Rsi,max}$ = 0.662
  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.

Climcatic conditions
Location: Greenock; 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	59.0	57.8	58.1	57.2	57.1	61.0	64.8	65.4	62.0	61.3	59.3	59.1
External temperature [°C]	Te	5.7	5.5	6.7	7.9	11.1	13.2	14.9	14.4	12.5	9.7	7.4	6.0
External rel. humidity [%]	phi_e	81.0	78.0	78.0	75.0	71.0	74.0	76.0	78.0	77.0	81.0	80.0	81.0

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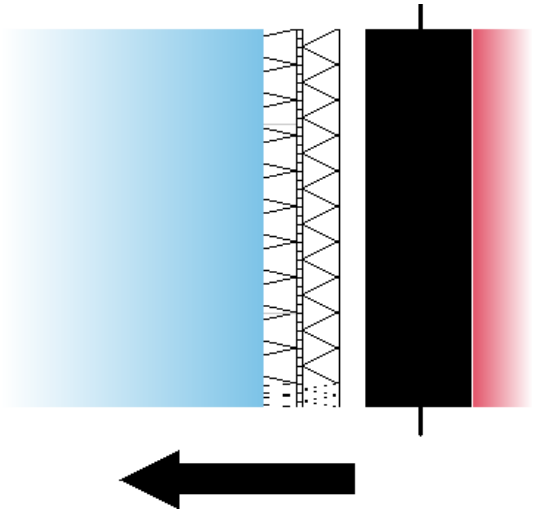
OUTSIDE INSIDE



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	Gyproc Wallboard	0.0150	0.190	D	1.00	D	680.0	D	~~10.2~~	A, -, C
2	Light steel-frame consisting of:	0.1500							~~0.9~~	A, -, -
2a	Mineral wool quilt - Variable thickness	99.83%	0.042	D	1.03	D	12.0	D	~~1.9~~	A, -, C
2b	Steel	00.17%	50.000	D	0.45	D	7800.0	D	~~0.9~~	A, -, -
3	GTEC Weather Defence 12.5mm	0.0125	0.190	B	1.00	C	860.0	B	~~10.8~~	A, -, C
4	Kingspan Kooltherm K8 Cavity Board 45-100mm	0.0700	0.022	D	1.40	D	40.0	D	~~0.0~~	A, -, C
5	Unventilated air layer: 50 mm, horiz. heat flow	0.0500	0.278	D	1.01	D	1.2	D	~~0.1~~	A, -, -
6	Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregarding acc. BRE 4.4.3)	0.0020	0.770	D	0.80	D	1700.0	D	~~2.7~~	A, -, -
6	Brick outer leaf & Mortar outer leaf (f = 0.000 / automatic disregarding acc. BRE 4.4.3)	0.1000	0.770	D	0.80	D	1700.0	D	136.0	-, -, -
	Start of calculation - Warm									
		0.3995							**136.0**	

Heat capacity = 136.0 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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