CONSTRUCTION MATERIALS.

THERMAL PERFORMANCE CALCULATION

FEA

Façade Engineering and Analysis Services Limited.

Analysis undertaken and report prepared on behalf of Conservatory Insulations Ltd for....

GARDEN ROOM WALL

DOCUMENT REF :- CIL/TP/24081 Rev 01
Document title :- U value and condensation risk analysis of typical Garden Room wall.
Date of original issue :- 21 February 2024
Revised issue date :-

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Revisions

Rev 01	Initial issue of document	21 February 2024

This document provides an assessment of the thermal performance only and does not indicate or contain assessments of the façade suitability regarding any other aspects, including but not limited to, structural and fire resistance. These must be assessed by the client and their specialist engineers.

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Summary

This document contains thermal analysis of the typical Garden Room through wall construction to assess the U value and condensation risk analysis in accordance with BS EN ISO 13788.

The calculation has been undertaken on behalf of Conservatory Insulations Ltd T/A Elite Garden Studios and has been undertaken using the BuildDesk U software 3.4.6.

The wall construction is a ventilated outer cladding supported by a backing wall.

By convention, from BR443, the external cladding element is ignored in U value calculations but an amendment to the external surface resistance of the insulating material is made to allow for the sheltering effect of the cladding and penetrating brackets through the insulation must be allowed for. See analysis notes for further details.

The examined construction consists of a SIP constructed from 11mm OSB inner and outer skins sandwiching a 100mm EPS insulation (λ=0.031 W/mK).*

A 25mm cavity with timber battens is to the inside of the SIP with a Conservaheat Multifoil insulation ** applied to that.

A further 25mm cavity with timber battens supports a 9.5mm plasterboard internal finish.

Analysis of the examined area shows that the construction achieves a U value of 0.16 W/m^{2}K.

A condensation risk analysis in accordance with BS EN ISO 13788:2002 shows that no condensation will occur in the construction assessed.

(*) value taken from previous calculations supplied by CIL

(**) The λ value of the that element is calculated from an advised thermal resistance of 2.35 taken to be applicable to the foil fitted at a 6mm thickness. The vapour resistance of the material is assumed to be as the foil elements within it.

Wall construction

Documentation of the component 21. February 2024
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - External walls**
Component: **Con Insul gardem room wall**

OUTSIDE INSIDE

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.

Assignment: External wall

		Manufacturer	Name	Thickness [m], number	Lambda [W/(mK)]	Q	R [m²K/W]
		Rse					0.1300
☐	1	Own catalogue	Cladding	0.0030	0.940	I	~~0.0032~~
☐	2	BS EN ISO 6946	Well ventilated air layer	0.0250	0.000	D	-
☑	3	BS EN 12524	Breather membrane	0.0001	0.170	D	0.0006
☑	4	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	5	Own catalogue	EPS insulation 0.031	0.1000	0.031	I	3.2258
		Air gaps	Level 1: dU" = 0.01 W/(m²K)				
☑	6	BS EN 12524	Oriented strand board (OSB)	0.0110	0.130	D	0.0846
☑	7	Inhomogeneous material layer	consisting of:	0.0250	ø 0.138		0.1808
	7a	BS EN ISO 6946	Unventilated air layer: 25 mm, horiz. heat flow	91.67 %	0.139	D	-
	7b	BS EN 12524	Softwood Timber [500 kg/m³]	08.33 %	0.130	D	-
☑	8	FEASL	Conservaheat	0.0060	0.003	I	2.3529
☑	9	Inhomogeneous material layer	consisting of:	0.0250	ø 0.138		0.1808
	9a	BS EN ISO 6946	Unventilated air layer: 25 mm, horiz. heat flow	91.67 %	0.139	D	-
	9b	BS EN 12524	Softwood Timber [500 kg/m³]	08.33 %	0.130	D	-
☑	10	Knauf Drywall	Knauf Wallboard	0.0095	0.160	D	0.0594
		Rsi					0.1300
				0.2156			

☐ was not taken into consideration in the calculation

Documentation of the component 21. February 2024
Thermal transmittance (U-value) according to BS EN ISO 6946
Source: **own catalogue - External walls**
Component: **Con Insul gardem room wall**

$R_T = (R_T' + R_T'')/2 = 6.43$ m²K/W

Correction to U-value for	according to	delta U [W/(m²K)]
Air gaps	BS EN ISO 6946 Annex F	~~0.0025~~

Air gaps and fixings corrections need not be applied, as their total effect is less than 3% (Annex D BS 6946:1996).

0.0000

$U = 1/R_T + \Sigma\Delta U = 0.16$ 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.
D .. D: Information is entered by BuildDesk without special agreement with the manufacturer, supplier or others.
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Documentation of the component
Thermal transmittance (U-value) according to BS EN ISO 6946
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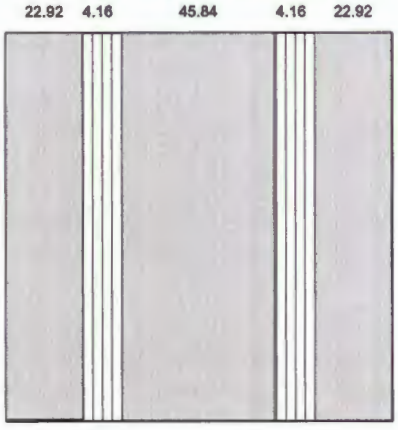
21. February 2024

Draft of the component (portion in %):



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

A	22.92 + 45.84 + 22.92 consisting of material layers: 3, 4, 5, 6, 7a, 8, 9a, 10	= 91.67%
B	4.17 + 4.17 consisting of material layers: 3, 4, 5, 6, 7b, 8, 9b, 10	= 8.33%

Upper limit of the thermal transfer resistance R

U_A [W/(m²K)] = $\frac{1}{(\Sigma R_{i,A}) + R_{si} + R_{se}}$ = $\frac{1}{6.17 + 0.13 + 0.13}$ = 0.16

U_B [W/(m²K)] = $\frac{1}{(\Sigma R_{i,B}) + R_{si} + R_{se}}$ = $\frac{1}{6.19 + 0.13 + 0.13}$ = 0.15

$$R_T' = \frac{1}{A * U_A + B * U_B} = 6.43 \text{ m}^2\text{K/W}$$

Lower limit of the thermal transfer resistance R

R_{se} [m²K/W]		= 0.13
R_3" [m²K/W] = d_3/λ_3 =	0.0001 / 0.170	= 0.00
R_4" [m²K/W] = d_4/λ_4 =	0.0110 / 0.130	= 0.08
R_5" [m²K/W] = d_5/λ_5 =	0.1000 / 0.031	= 3.23
R_6" [m²K/W] = d_6/λ_6 =	0.0110 / 0.130	= 0.08
R_7" [m²K/W] = $d_7/(\lambda_{7a} * A + \lambda_{7b} * B)$ =	0.0250 /(0.139 * 91.67% + 0.130 * 8.33%)	= 0.18
R_8" [m²K/W] = d_8/λ_8 =	0.0060 / 0.003	= 2.35
R_9" [m²K/W] = $d_9/(\lambda_{9a} * A + \lambda_{9b} * B)$ =	0.0250 /(0.139 * 91.67% + 0.130 * 8.33%)	= 0.18
R_{10}" [m²K/W] = d_{10}/λ_{10} =	0.0095 / 0.160	= 0.06
R_{si} [m²K/W]		= 0.13

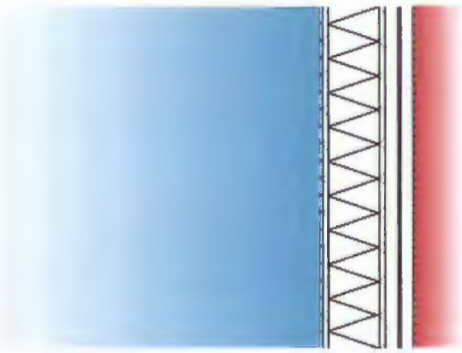
$$R_T'' = \Sigma R_i'' + R_{si} + R_{se} = 6.43 \text{ m}^2\text{K/W}$$

FEA
Façade Engineering and Analysis
Services Limited.

Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - External walls**
Component: **Con Insul gardem room wall**

21. February 2024

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]
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
EPS insulation 0.031	0.1000	0.031	E	150.00	E	15.00	3.2258
Oriented strand board (OSB)	0.0110	0.130	D	30.00	D	0.33	0.0846
Unventilated air layer: 25 mm, horiz. heat flow	0.0250	0.139	D	1.00	D	0.03	0.1799
Conservaheat	0.0060	0.003	E	999999.0 0	E	5999.99	2.3529
Unventilated air layer: 25 mm, horiz. heat flow	0.0250	0.139	D	1.00	D	0.03	0.1799
Knauf Wallboard	0.0095	0.160	D	4.00	D	0.04	0.0594

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Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - External walls**
Component: **Con Insul gardem room wall**

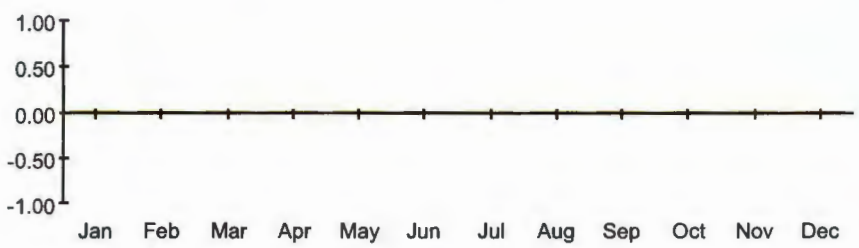
21. February 2024

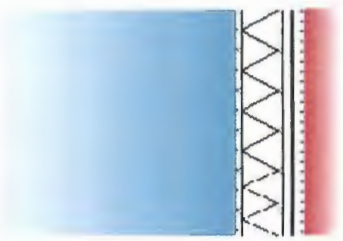
Condensation risk analysis - summary of main results
Calculation according BS EN ISO 13788

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

Documentation of the component
Calculation according BS EN ISO 13788
Source: **own catalogue - External walls**
Component: **Con Insul gardem room wall**

21. February 2024

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

Location: London (Heathrow); Humidity class according BS EN ISO 13788 annex A: legacy; Dwellings with low 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 [°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]
● January	3.9	0.880	20.0	0.611	710	717	1428	1784	15.7	0.734	19.4	4.0
February	3.7	0.860	20.0	0.604	684	726	1411	1763	15.5	0.726	19.4	3.8
March	5.9	0.810	20.0	0.591	752	628	1380	1725	15.2	0.659	19.5	6.0
April	7.8	0.750	20.0	0.572	793	544	1337	1671	14.7	0.565	19.5	7.9
May	11.6	0.730	20.0	0.587	997	374	1371	1714	15.1	0.415	19.7	11.7
June	14.7	0.730	20.0	0.623	1220	236	1457	1821	16.0	0.251	19.8	14.7
July	16.9	0.720	20.0	0.652	1386	138	1524	1905	16.7	0.000	19.9	16.9
August	16.6	0.740	20.0	0.663	1397	151	1549	1936	17.0	0.116	19.9	16.6
September	13.9	0.790	20.0	0.653	1254	272	1526	1907	16.8	0.469	19.8	13.9
October	10.2	0.850	20.0	0.639	1057	437	1494	1867	16.4	0.635	19.6	10.3
November	6.6	0.880	20.0	0.622	857	597	1454	1818	16.0	0.702	19.5	6.7
December	4.9	0.900	20.0	0.621	779	673	1452	1815	16.0	0.734	19.4	5.0

- The critical month is January with $f_{Rsi,max} = 0.734$
  $f_{Rsi} = 0.961$

$f_{Rsi} > f_{Rsi,max}$, 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 $\phi_{si} = 0.8$ (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: London (Heathrow); Humidity class according BS EN ISO 13788 annex A: legacy; Dwellings with low 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	61.1	60.4	59.1	57.2	58.7	62.3	65.2	66.3	65.3	63.9	62.2	62.1
External temperature [°C]	Te	3.9	3.7	5.9	7.8	11.6	14.7	16.9	16.6	13.9	10.2	6.6	4.9
External rel. humidity [%]	phi_e	88.0	86.0	81.0	75.0	73.0	73.0	72.0	74.0	79.0	85.0	88.0	90.0