

THERMAL SIMULATION REPORT

Report Number:	WIN2022-GGL-001
Prepared For:	Granada Glazing Ltd. Campbell Way Dinnington Sheffield S25 3QD
Primary (External) Window:	Timber frame, single 4mm float glass
Secondary (Internal) Window:	Aluminium Slimline Hinged, single 6mm Pilkington K glass
Notes:	Assumed minimum air gap of 50mm between primary and secondary windows.

Results

Thermal Transmittance – Primary Window	4.7	W/(m²K)
Thermal Transmittance – Secondary Window	4.1	W/(m²K)
Thermal Transmittance – Combined Windows	1.4	W/(m²K)
Percentage Reduction compared to Primary	70	%

(Window Configuration – 1230mm wide x 1480mm high as per the requirements of ADL and EN 14351)

Report Prepared By:

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Signed:



Date:

20th December 2022

The simulations in this report were performed using Win Iso ® version 2.8.0, strictly in accordance with the requirements of BS EN ISO 10077-2:2017, using the radiosity approach to frame cavity modelling.

The overall window U value was determined in accordance with the requirements of BS EN ISO 10077-1:2017.

The simulation files and spreadsheet generated are attached to this report as appendices. All material thermal conductivity values are taken from BS EN ISO 10077-2:2017 unless otherwise stated.



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Primary Window

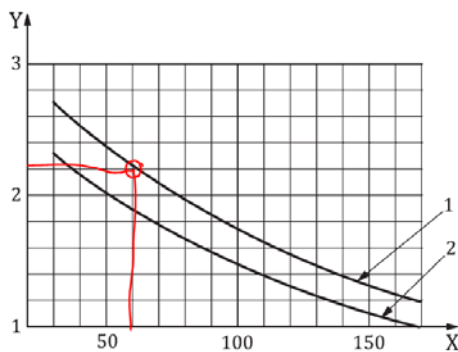
Primary window U-value estimate based on BS EN ISO 10077-1 – Annex F and Annex H.

Single-glazed hardwood window.

Annex F

Assume 60mm solid hardwood frame: -

ISO 10077-1:2017(E)



Key

- X thickness of frame, d_f , expressed in millimetres
- Y thermal transmittance of frame, U_f , in $W/(m^2 \cdot K)$
- 1 hardwood (density 700 kg/m^3), $\lambda = 0,18 \text{ W/(m} \cdot \text{K)}$
- 2 softwood (density 500 kg/m^3), $\lambda = 0,13 \text{ W/(m} \cdot \text{K)}$

Figure F.2 — Thermal transmittances for wooden frames and metal-wood frames (see Figure F.3) depending on the frame thickness, d_f

Gives $U_f = 2.2 \text{ W/(m}^2\text{K)}$

Annex H

Table H1 gives: -

Table H.1 — Thermal transmittances, U_{f0} , for vertical windows with fraction of the frame area 30 % of the whole window area, common types of glazing spacer bars

Type of glazing	U_g	Thermal transmittances, U_{f0} , for vertical windows with fraction of the frame area 30 % of the whole window area for common types of glazing spacer bars and following U_f values													
		0.80	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.6	3.0	3.4	3.8	7.0	
Single	5.8	4.3	4.4	4.4	4.5	4.5	4.6	4.7	4.7	4.8	5.0	5.1	5.2	6.1	
	3.3	2.7	2.8	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	4.5	
	3.2	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.2	3.3	3.5	3.6	4.4	
	3.1	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.1	3.3	3.4	3.5	4.3	
	3.0	2.5	2.5	2.6	2.7	2.7	2.8	2.8	3.0	3.1	3.2	3.3	3.4	4.2	
	2.9	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.1	3.2	3.4	4.2	
	2.8	2.3	2.4	2.5	2.5	2.6	2.6	2.7	2.8	2.9	3.1	3.2	3.3	4.1	
	2.7	2.3	2.3	2.4	2.5	2.5	2.6	2.6	2.7	2.9	3.0	3.1	3.2	4.0	
	2.6	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.7	2.6	2.9	3.0	3.2	4.0	
	2.5	2.1	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.5	2.8	3.0	3.1	3.9	
Double or triple	2.4	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.8	2.9	3.0	3.8	
	2.3	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.5	2.4	2.7	2.8	3.0	3.8	
	2.2	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.4	2.3	2.6	2.8	2.9	3.7	
	2.1	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3	2.6	2.7	2.8	3.6	
	2.0	1.8	1.9	2.0	2.0	2.1	2.1	2.2	2.3	2.5	2.6	2.7	2.8	3.6	
	1.9	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.3	2.4	2.5	2.5	2.7	3.6	
	1.8	1.7	1.8	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7	3.5	
	1.7	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.4	2.5	2.6	3.4	
	1.6	1.6	1.6	1.7	1.7	1.8	1.9	1.9	2.1	2.2	2.3	2.4	2.5	3.3	
	1.5	1.5	1.5	1.6	1.7	1.7	1.8	1.8	2.0	2.1	2.2	2.3	2.5	3.3	
	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.2	2.3	2.4	3.2	
	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8	2.0	2.1	2.2	2.3	3.1	
	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.6	1.8	1.9	2.0	2.1	2.3	3.1	
	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	3.0	
	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.9	
	0.9	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.6	1.7	1.8	1.9	2.0	2.9	
	0.8	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	2.8	
	0.7	0.93	0.99	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.7	1.8	1.9	2.7	
	0.6	0.86	0.92	0.98	1.0	1.1	1.2	1.2	1.4	1.5	1.6	1.7	1.8	2.7	
	0.5	0.79	0.85	0.91	0.97	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.8	2.6	

Thus, U_w of primary window = $4.7 \text{ W/(m}^2\text{K)}$

Secondary Window

U Value / Energy Rating Spreadsheet - Dual Vent Casement Window						
		Report No:	WIN2022-GSG001			
		Report Date:	20 December 2022			
		System Details	Slimline Hinged Unit - Secondary Glazing			
		Window Height	1480	mm	Air leakage/m @ 50Pa	
Window Width	1230	mm				
Glazing Properties	Left Pane	Right Pane				
U value (W/m2K)	3.60		3.60			
g value			0.00			
Light Transmission			0.00			
Frame Properties	b _f (mm)	Frame Offset	Gasket Protrusion	U _f (W/m ² K)	ψ (W/mK)	
F1 - Fixed Left Head Rail	30.3			5.9974	0.0000	
F2 - Moving Left Head Rail	27.0	0.0	2.0			
F3 - Fixed Right Head Rail	30.3			5.9974	0.0000	
F4 - Moving Right Head Rail	27.0	0.0	2.0			
F5 - Fixed Left Hinge Jamb	30.3			5.9974	0.0000	
F6 - Moving Left Hinge Jamb	27.0	0.0	2.0			
F7 - Fixed Right Hinge Jamb	30.3			5.9974	0.0000	
F8 - Moving Right Hinge Jamb	27.0	0.0	2.0			
F9 - Fixed Left Sill	30.3			5.9974	0.0000	
F10 - Moving Left Sill	27.0	0.0	2.0			
F11 - Fixed Right Sill	30.3			5.9974	0.0000	
F12 - Moving Right Sill	27.0	0.0	2.0			
F13 - Meeting Rail	58.0	0.0	2.0	6.6762	0.0000	
		0.0	2.0			
Frame Element	Area (m ²)	Sight Line (m)	Heat Flow (W/K)	This spreadsheet is the property of Windata Ltd. Unauthorised copying, modification or distribution is expressly forbidden under UK copyright law.		
Left Head Rail	0.033206355	0.5287	0.199151793			
Right Head Rail	0.033206355	0.5287	0.199151793			
Left Hinge Jamb	0.08152071	1.3654	0.488912306			
Right Hinge Jamb	0.08152071	1.3654	0.488912306			
Left Sill	0.033206355	0.5287	0.199151793			
Right Sill	0.033206355	0.5287	0.199151793			
Meeting Rail	0.0807592	1.3654	0.539164571			
Left Glazing Pane	0.72188698		2.598793128			0.71432658
Right Glazing Pane	0.72188698		2.598793128			0.71432658
		Total	7.511182613	Area inc. gaskets (m ²)		
Seal Length (m)	6.60	L ₅₀ (m ³ /(m ² .h))	0.00			
Thermal Transmittance, W/(m ² .K)	4.13					
Air Leakage Heat Loss, W/(m ² .K)	N/A					
Solar Gain (g) value	N/A					
Visible Light Transmittance value	N/A					
Window Energy Rating, kWh/(m ² .yr)	N/A					
Energy Rating Band	N/A					

Note – The linear thermal transmittance (Ψ_g) for the secondary glazing has been set at zero in accordance with BS EN ISO 10077-2, Clause 6.3.2.5

Combined Windows

Determination of Thermal Performance of Secondary Glazing

$$U_w = \frac{1}{1/U_{W1} - R_{si} + R_s - R_{se} + 1/U_{W2}} \quad (4)$$

where

U_{W1}, U_{W2} are the thermal transmittances of the external and internal window, respectively, calculated according to [Formula \(2\)](#);

R_{si} is the internal surface resistance of the external window when used alone;


R_{se} is the external surface resistance of the internal window when used alone;

R_s is the thermal resistance of the space between the glazing in the two windows.

(BS EN ISO 10077-1:2017 Clause 6.4.2.1.2)

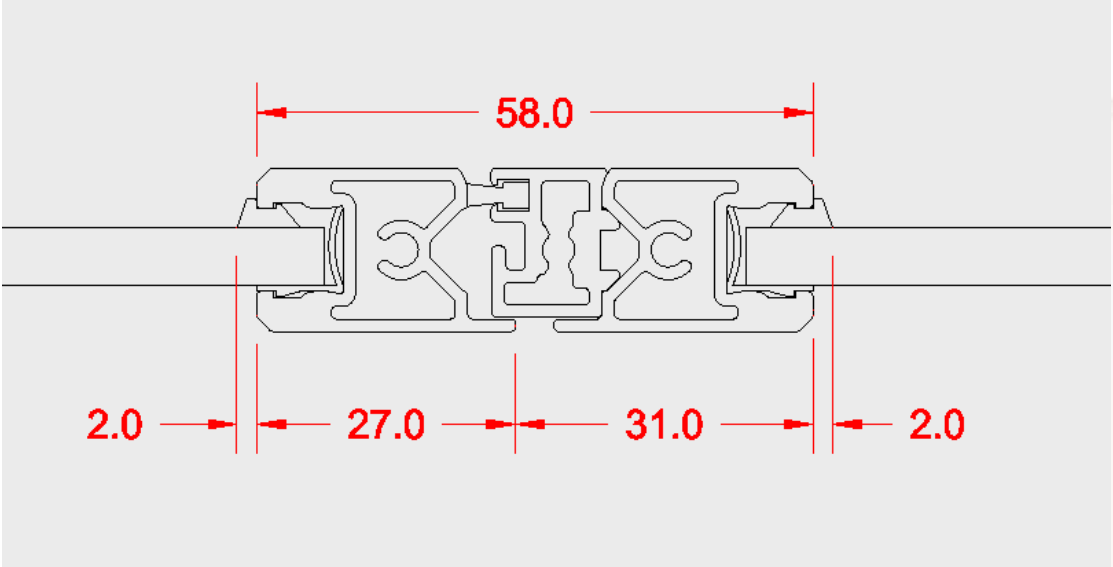
U_{W1}	4.7	W/(m ² .K)	Primary (External) Window
U_{W2}	4.1	W/(m ² .K)	Secondary (Internal) Window
R_{si}	0.13	m ² .K/W	(BS EN ISO 10077-1 - Annex D)
R_{se}	0.04	m ² .K/W	(BS EN ISO 10077-1 - Annex D)
R_s	0.406	m ² .K/W	(BS EN ISO 10077-1 - Annex E)

Thickness of Air Space	50	mm
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U_w - combined	1.4	W/(m ² .K)	
U_w reduction	70%	%	



Meeting Rail Detail



Glazing Performance

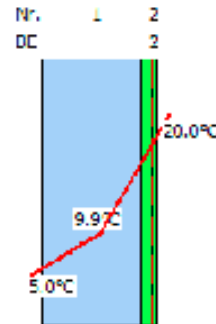
Calculation SommerGlobal

Project: 2022_12_19

Position: 01

Layer composition (outside to inside)

Number	BE	Description	mm
1		Optifloat	6.00
2	2	K Glass N (en=13%)	6.00



Transmission, reflexion, absorption

$\rho_v = 0.11$ (Light reflection factor outside)

$\rho'_v = 0.12$ (Light reflection factor inside)

$\rho_e = 0.10$ (direct radiation reflection factor outside)

$\rho'_e = 0.11$ (direct radiation reflection factor inside)

$\alpha_e = 1 = 0.20$ (direct radiation absorption factor)

$T_{UV} = 0.47$ (ultraviolet transmittance)

$T_v = 0.82$ (Light transmission)

$T_e = 0.70$ (direct radiation transmission factor)

$R_a = 100$ (general color rendering index (CRI))

EN 410

SC = 0.84 (Shading Coefficient, g/0,87)

b-Faktor = 0.91 (VDI 2078, g/0,80)

$q_i = 0.03$ (secondary heat inside)

$g = 0.73$ (Total energy transmission factor)

EN 673 Installation angle = 90° vertical

$U_g = 3.6 \text{ W/m}^2\text{K}$ (Heat transfer coefficient)
Corrected emissivity according to EN 12898:2019

EN ISO 52022-3 $T_e = 5.00 \text{ }^\circ\text{C}$ $T_i = 20.00 \text{ }^\circ\text{C}$

$g_{th} = 0.006$ (Thermal radiation factor)

$g_c = 0.025$ (Convection factor)

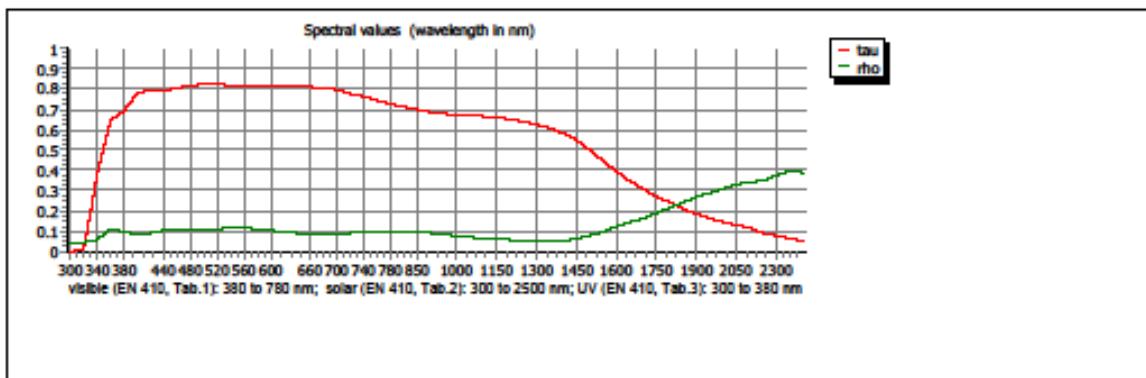
$g_v = 0.000$ (Ventilation factor)

$E_s = 300.00 \text{ W/m}^2$ System height = 1.50 m

$h_{c,e} = 18.00 \text{ W/m}^2\text{K}$ $h_{c,i} = 3.60 \text{ W/m}^2\text{K}$

$q_i = 0.031$ (secondary heat inside)

$g_{tot} = 0.73$ (Total energy transmission factor)



Fluctuations of light and radiation technical values for the chemical composition of glass and manufacturing process possible. Function values take into account the permitted tolerances according to the product standards. The calculation result does not give information about the technical practicability of this construction. We point out that the calculations were created on the basis of the manufacturers' spectral data. The company Sommer Informatik GmbH assumes no liability for the integrity of the manufacturers' data. For the declaration of performance the manufacturers' data placed at the disposal has to be confirmed separately.

EN 410, EN 673, EN ISO 52022-3, EN 12898:2019

ift-certified It. validation report no. 410 42167 (status as of 11/2009)

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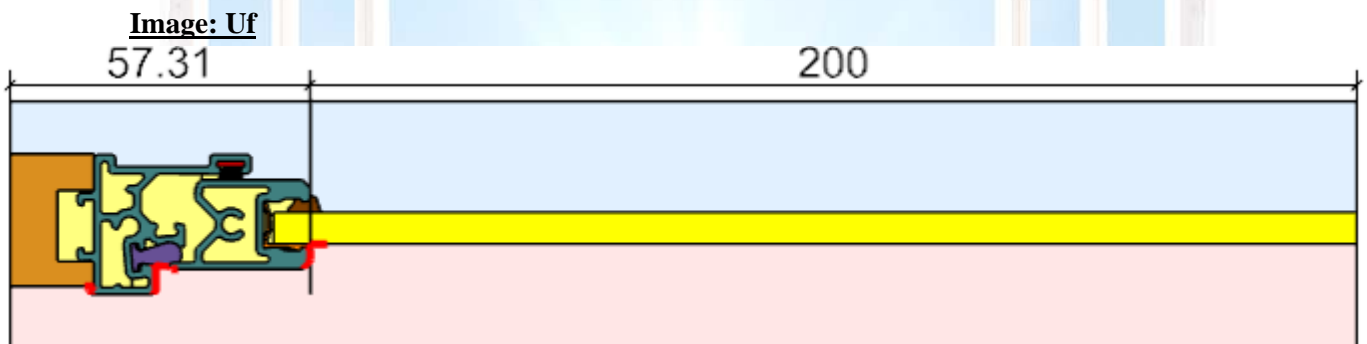
SommerGlobal 7.4203

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ADMIN

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Simulation Models and Results



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U_f-Value

$$Q_{\text{tot}} = 18.580 \frac{\text{W}}{\text{m}} \quad \Delta T = 20 \text{ K}$$

$$L_{2D} = \frac{Q_{\text{tot}}}{\Delta T} = 0.9290 \frac{\text{W}}{\text{m} \cdot \text{K}}$$

$$U_p = 2.926 \frac{\text{W}}{\text{m} \cdot \text{K}}$$

Width of panel = 200 mm (b_p)

Width of frame = 57 mm (b_f)

$$U_f = \frac{L_{2D} - U_p \cdot b_p}{b_f} = \frac{0.9290 - 2.9264 \cdot 0.20000}{0.05731} = 6.0 \text{ (5.9974)} \frac{\text{W}}{\text{m}^2 \cdot \text{K}}$$

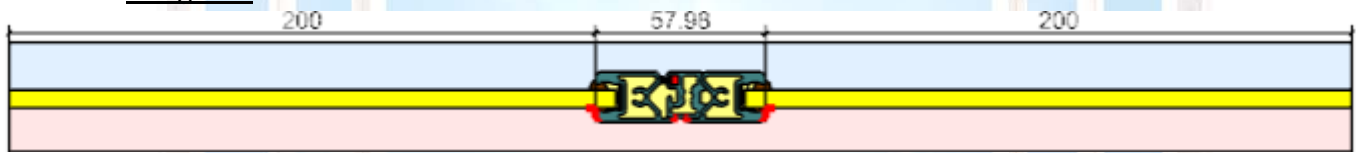
Boundaries	R [m ² K/W]	T [°C]	Q _{ges} [W/m]
Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-18.580
Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	16.829
Boundary condition internal 20°C 0.20	0.200	20.000	1.751

Solids	A [mm ²]	λ [W/(mK)]	ε [-]
3 alu (Si-Leg.) 160	341.37	160.000	0.900
3 PVC-U Hard	12.43	0.170	0.900
3 softwood Rd = 500 kg / m ³	307.87	0.130	0.900
4 ABS (acrylic-butadiene-styrene)	5.30	0.200	0.900
5 brush seal	8.87	0.140	0.900
5 EPDM	12.93	0.250	0.900
5 Qlon Declared Value	34.75	0.041	0.900
Replacement panel EN ISO 10077-2	1244.02	0.035	0.900

Cavities	A [mm ²]
Unventilated air cavity - EN ISO 10077-2	495.90



Image: U_f



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U_f-Value

$$Q_{tot} = 31.173 \frac{W}{m} \quad \Delta T = 20 \text{ K}$$

$$L_{2D} = \frac{Q_{tot}}{\Delta T} = 1.5586 \frac{W}{m \cdot K}$$

$$U_p = 2.929 \frac{W}{m \cdot K} \quad \text{Width of panel} = 200 \text{ mm } (b_p)$$

$$\text{Width of frame} = 58 \text{ mm } (b_f)$$

$$U_f = \frac{L_{2D} - U_p \cdot b_p}{b_f} = \frac{1.5586 - 2.9289 \cdot 0.20000 - 2.9289 \cdot 0.20000}{0.05798} = 6.7 \text{ (6.6762)} \frac{W}{m^2 \cdot K}$$

Boundaries	R [m ² K/W]	T [°C]	Q _{ges} [W/m]
Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-31.173
Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	29.379
Boundary condition internal 20°C 0.20	0.200	20.000	1.793

Solids	A [mm ²]	λ [W/(mK)]	ε [-]
3 alu (Si-Leg.) 160	411.74	160.000	0.900
3 PVC-U Hard	24.98	0.170	0.900
4 ABS (acrylic-butadiene-styrene)	8.91	0.200	0.900
5 brush seal	7.07	0.140	0.900
5 EPDM	25.84	0.250	0.900
Replacement panel EN ISO 10077-2	2483.95	0.035	0.900

Cavities	A [mm ²]
Unventilated air cavity - EN ISO 10077-2	415.27