THERMAL SIMULATION REPORT

Report Number:	**WIN2022-GGL-002**
Prepared For:	**Granada Glazing Ltd. Campbell Way Dinnington Sheffield S25 3QD**
Primary (External) Window:	**Timber frame, single 4mm float glass**
Secondary (Internal) Window:	**Aluminium Horizontal Slider, 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/(m^{2}K)*
Thermal Transmittance – Secondary Window	**4.2**	*W/(m^{2}K)*
Thermal Transmittance – Combined Windows	**1.5**	*W/(m^{2}K)*
Percentage Reduction compared to Primary	**68**	*%*

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

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Signed: G Morgan

Date: ***22nd*** **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.

Primary Window

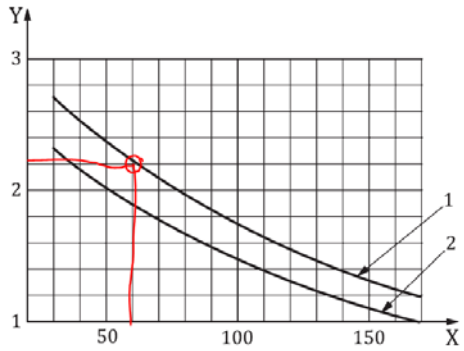
Primary window U-value estimate based on BS EN ISO 10077-1 – Annex F and Annex H.

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/(m²·K)
1 hardwood (density 700 kg/m³), λ = 0,18 W/(m·K)
2 softwood (density 500 kg/m³), λ = 0,13 W/(m·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 W/(m²K)

Annex H

Table H1 gives: -

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

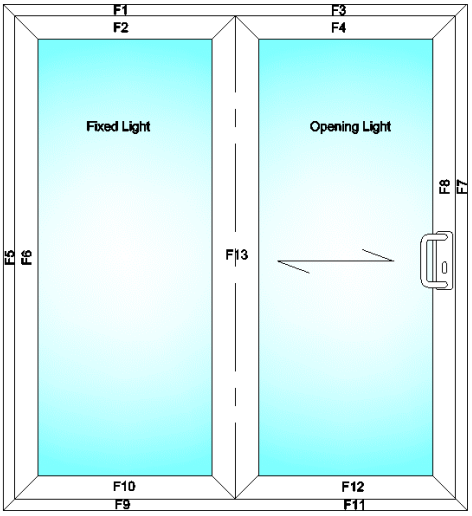
Values in W/(m²·K)

Type of glazing	U_g	Thermal transmittances, U_w, 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
Double or triple	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
	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 W/(m²K)

Secondary Window

U Value / Energy Rating Spreadsheet - Horizontal Sliding Window



Report No:	WIN 2022-GGL002		
Report Date:	22 December 2022		
System Details	Horizontal Sliding Secondary Glazing		
Window Height	1480 mm	Air leakage/m @ 50Pa	
Window Width	1230 mm		

Glazing Properties	Left Pane	Right Pane
U value (W/m2K)	3.6	3.6
g value		0
Light Transmission		0

Frame Properties	b_f (mm)	Frame Offset	Gasket Protrusion	Uf (W/m^{2}K)	ψ (W/mK)
F1 - Fixed Left Head Rail	0.0			6.3622	0.0000
F2 - Moving Left Head Rail	13.5	0.0	2.0		
F3 - Fixed Right Head Rail	0.0			7.9098	0.0000
F4 - Moving Right Head Rail	13.6	0.0	2.0		
F5 - Fixed Left Hinge Jamb	42.0			7.5821	0.0000
F6 - Moving Left Hinge Jamb	7.9	0.0	2.0		
F7 - Fixed Right Hinge Jamb	42.0			7.2960	0.0000
F8 - Moving Right Hinge Jamb	7.9	0.0	2.0		
F9 - Fixed Left Sill	42.0			6.4090	0.0000
F10 - Moving Left Sill	14.5	0.0	2.0		
F11 - Fixed Right Sill	42.0			7.3013	0.0000
F12 - Moving Right Sill	14.5	0.0	2.0		
F13 - Meeting Rail	22.0	0.0	2.0	10.3401	0.0000
		0.0	2.0		

Frame Element	Area (m^2)	Sight Line (m)	Heat Flow (W/K)	
Left Head Rail	0.007607925	0.5541	0.04840314	
Right Head Rail	0.00766428	0.5541	0.060622922	
Left Hinge Jamb	0.0721055	1.41	0.546711112	
Right Hinge Jamb	0.0721055	1.4099	0.526081728	
Left Sill	0.033119475	0.5541	0.212262715	
Right Sill	0.033119475	0.5541	0.241815223	
Meeting Rail	0.031328	1.40995	0.323934653	Area inc. gaskets (m^2)
Left Glazing Pane	0.781281		2.8126116	0.7734406
Right Glazing Pane	0.78122559		2.812412124	0.77338559
		Total	7.584855217	
Seal Length (m)	6.61	L_{50} (m^3/(m^2.h)	0.00	

Thermal Transmittance, W/(m^2.K)	4.17
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.

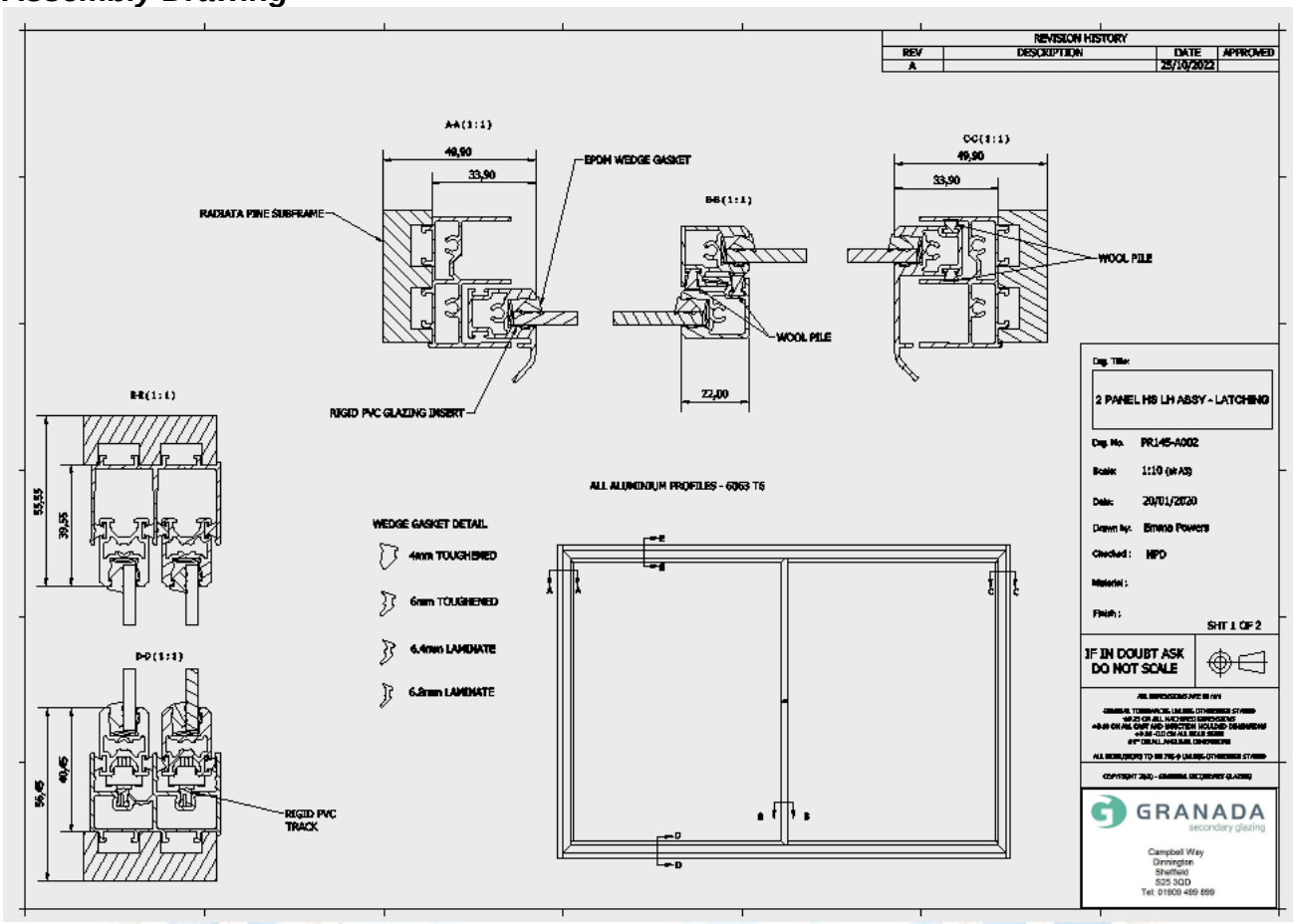
(BS EN ISO 10077-1:2017 Clause 6.4.2.1.2)

U_{W1}	**4.7**	W/(m^2.K)	Primary (External) Window
U_{W2}	**4.2**	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)

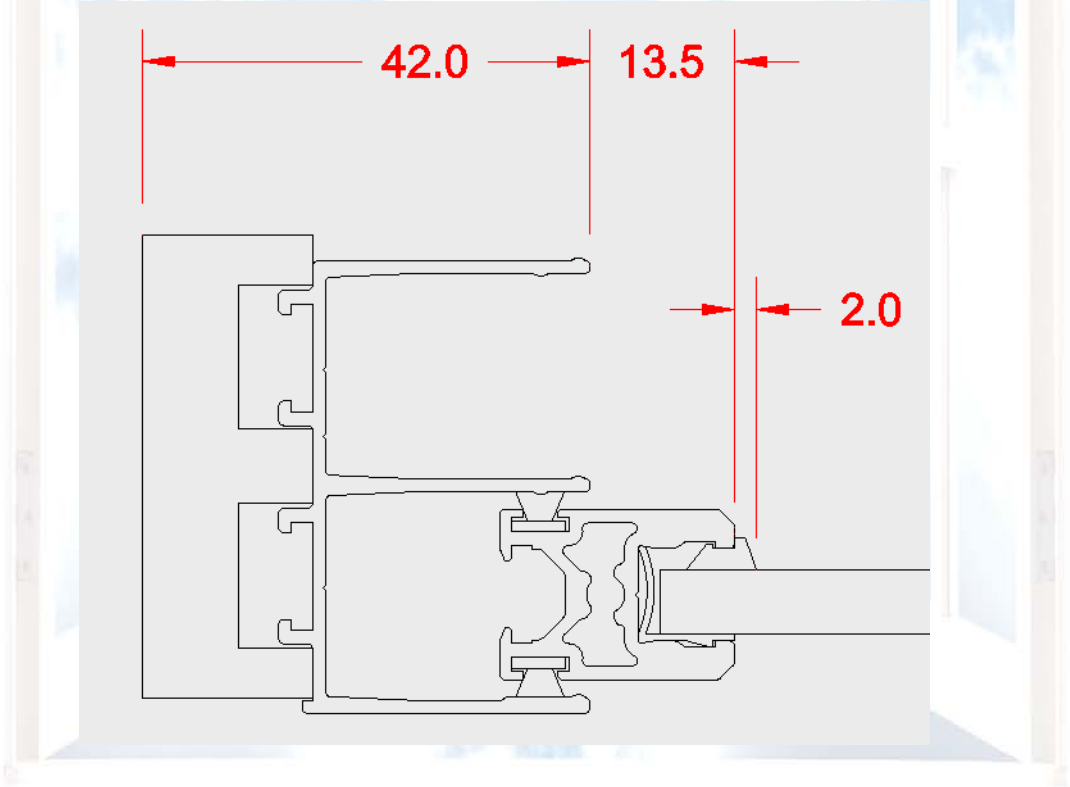
Thickness of Air Space	**50**	mm

U_w - combined	**1.5**	**W/(m^2.K)**
U_w reduction	**68%**	**%**

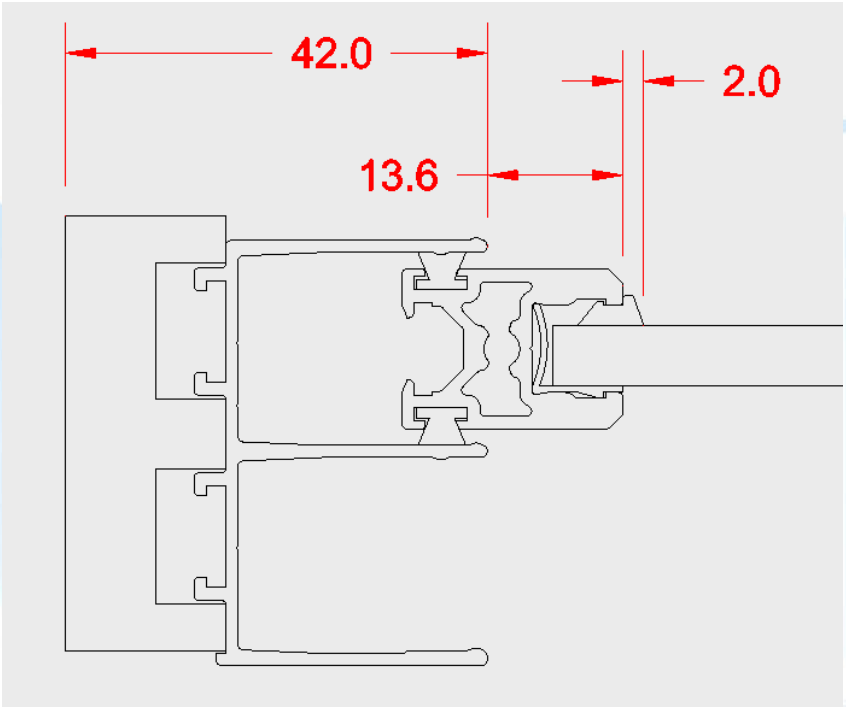
Assembly Drawing



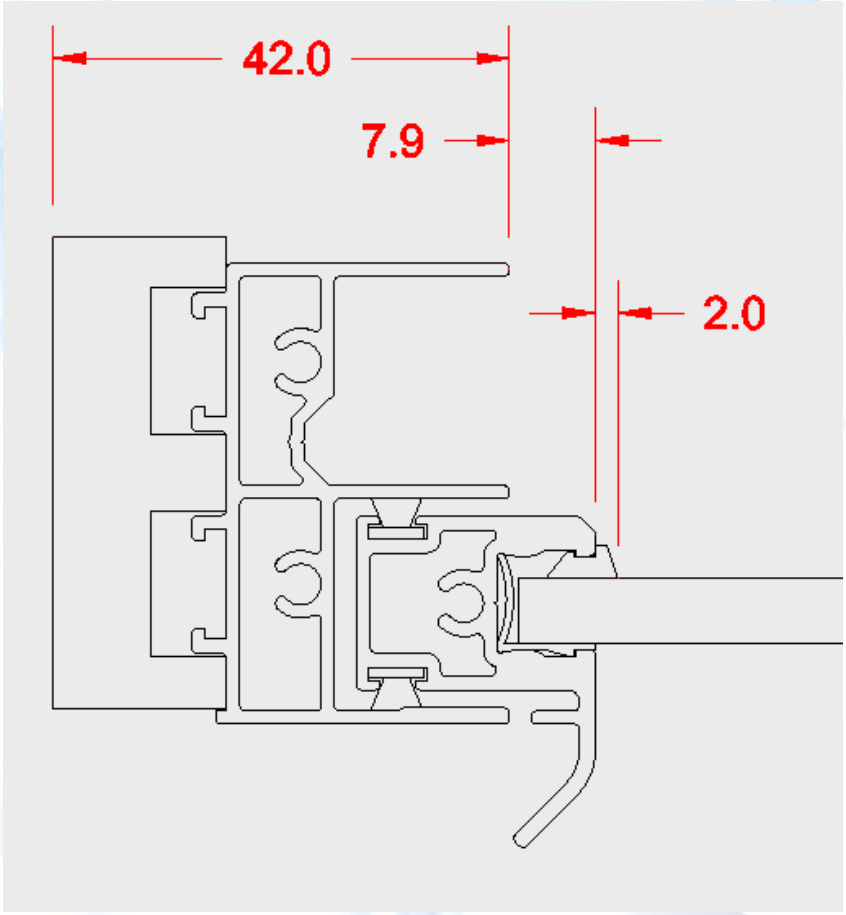
Left Head Rail Frame Section



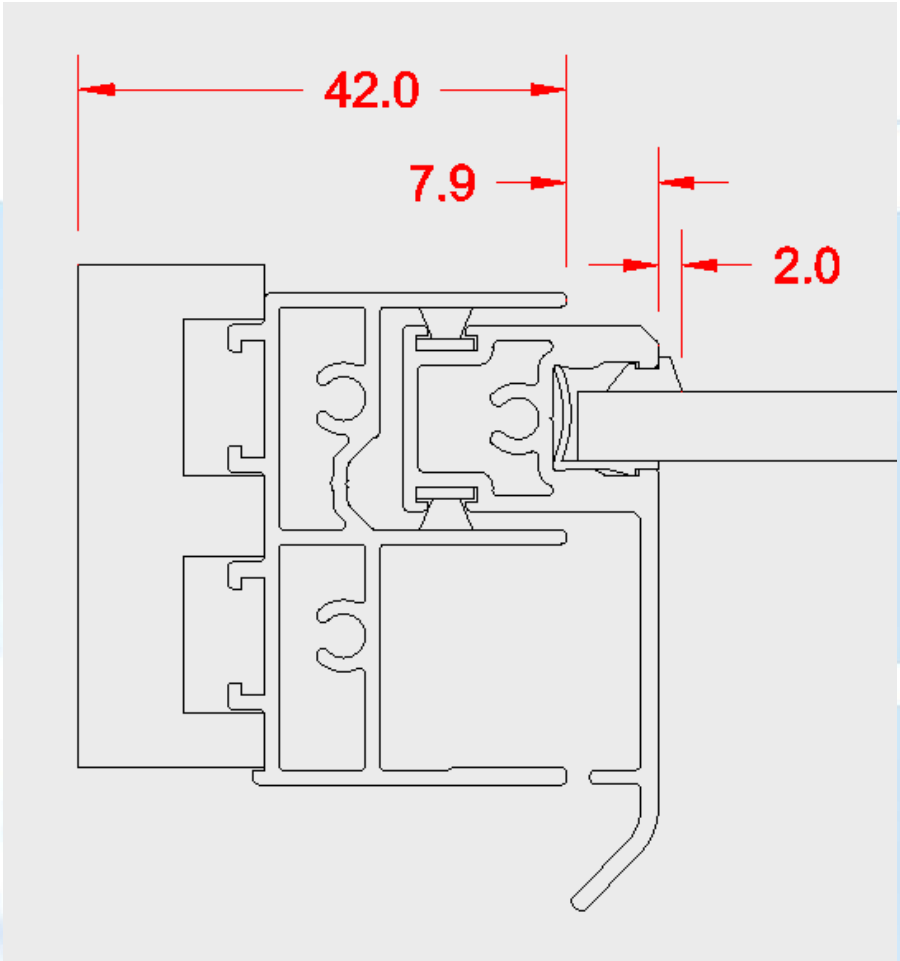
Right Head Rail Frame Section



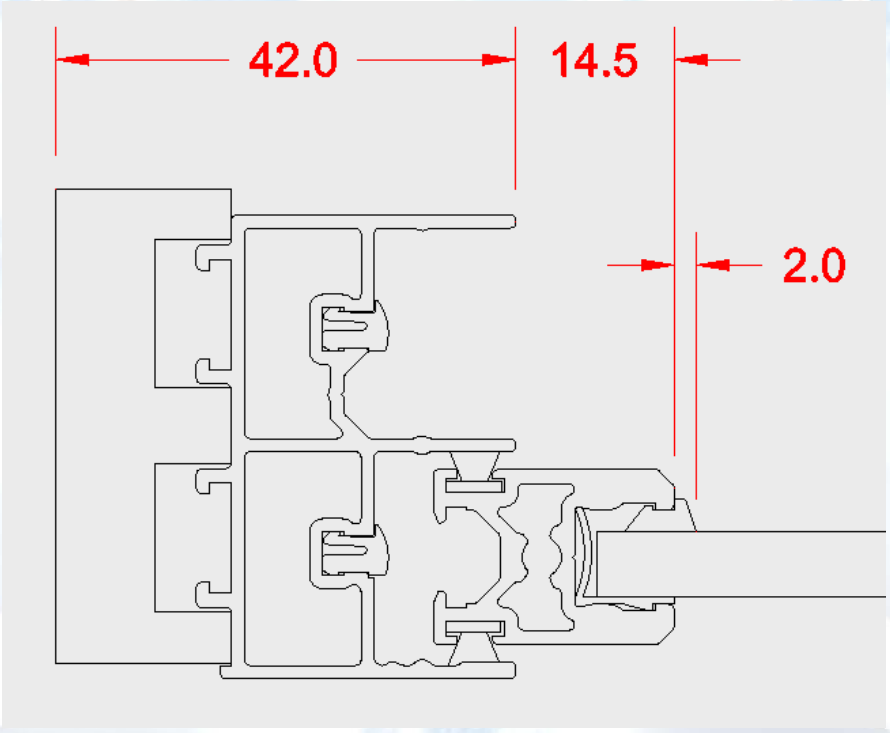
Left Jamb Frame Section



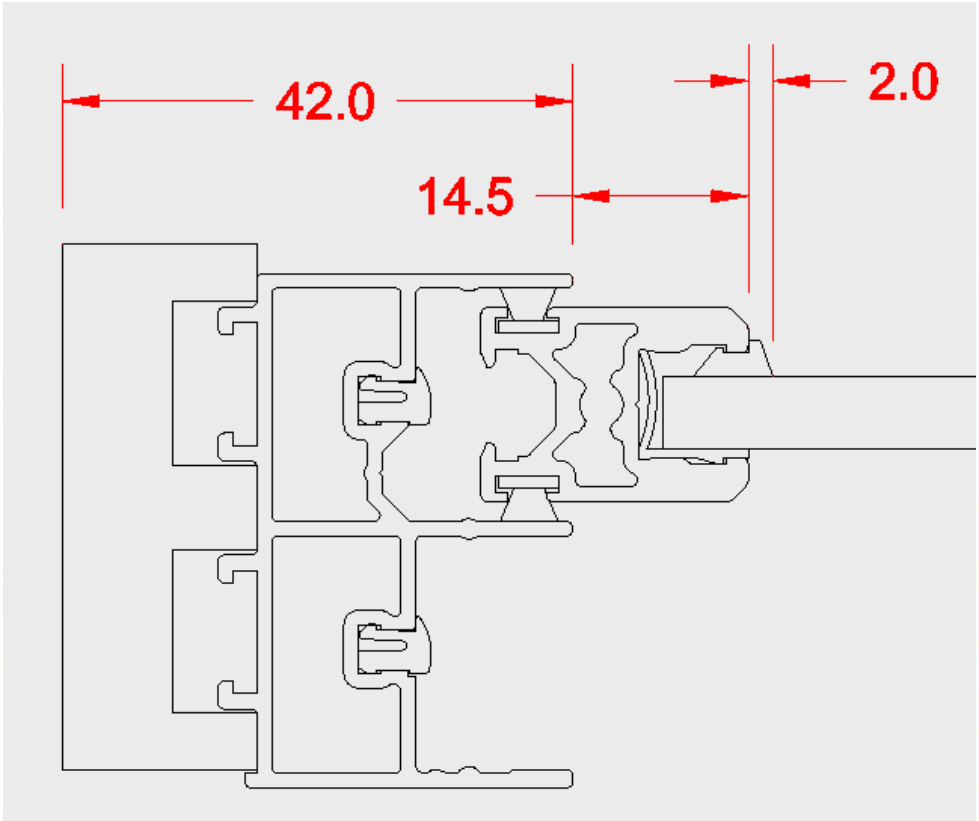
Right Jamb Frame Section



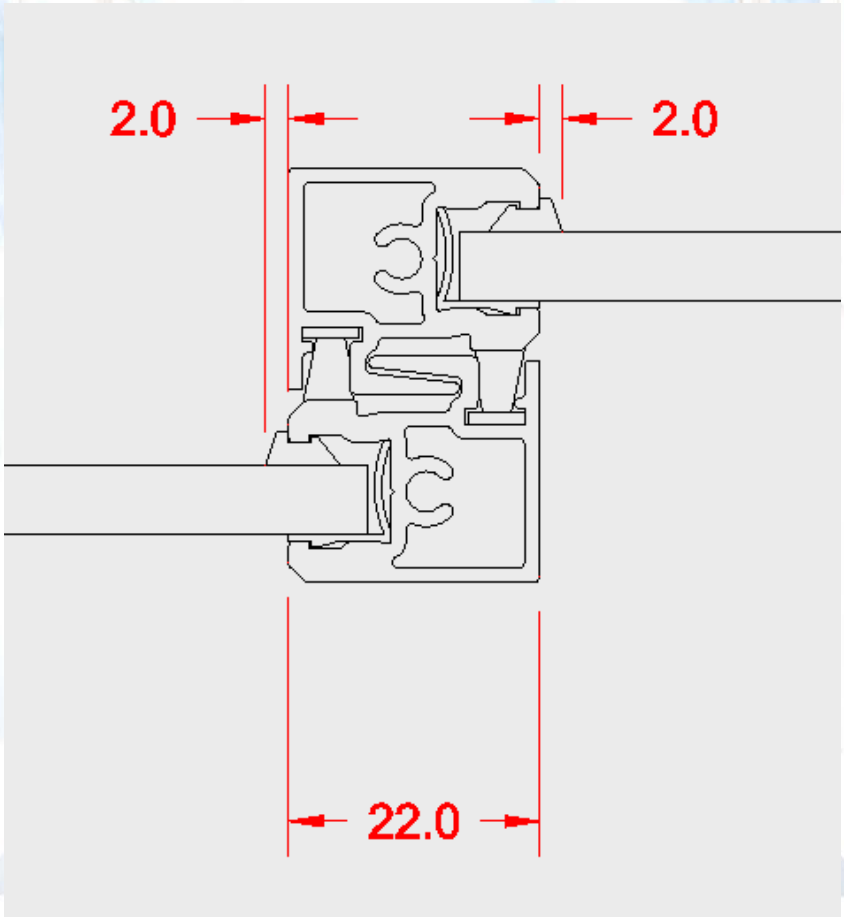
Left Sill Frame Section



Right Sill Frame Section



Meeting Rail Frame Section



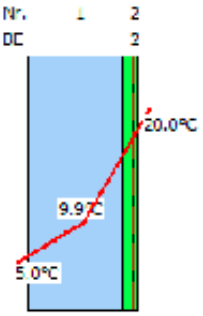
Glazing Performance

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 (εn=13%)	
			6.00



Transmission, reflexion, absorption

ρ_v = 0.11 (Light reflection factor outside)
ρ'_v = 0.12 (Light reflection factor inside)
ρ_e = 0.10 (direct radiation reflection factor outside)
ρ'_e = 0.11 (direct radiation reflection factor inside)
α_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)

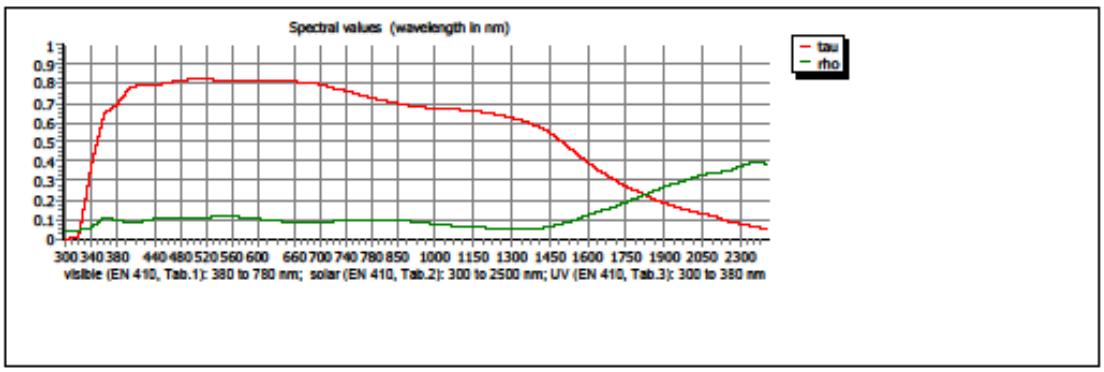
EN 673 Installation angle = 90° vertical

U_g = **3.6 W/m²K** (Heat transfer coefficient)
Corrected emissivity according to EN 12898:2019

EN ISO 52022-3 T_e = 5.00 °C T_i = 20.00 °C

g_{th} = 0.006 (Thermal radiation factor)
g_c = 0.025 (Convection factor)
g_v = 0.000 (Ventilation factor)

E_s = 300.00 W/m² System height = 1.50 m
$h_{c,e}$ = 18.00 W/m²K $h_{c,i}$ = 3.60 W/m²K
q_i = **0.031** (secondary heat inside)
g_{tot} = **0.73** (Total energy transmission factor)

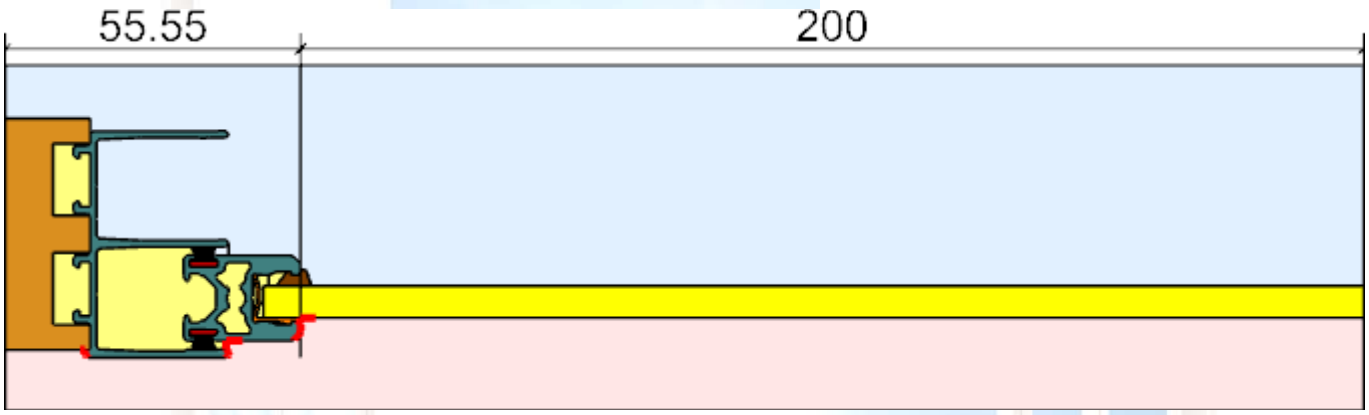


EN 410, EN 673, EN ISO 52022-3, EN 12898:2019

ift-certified lt. validation report no. 410 42167 (status as of 11/2009)
Registered for: Windata Ltd. - Windata Ltd.
ADMIN

Simulation Models and Results

Image: Uf



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U_f-Value

$Q_{tot} = 18.784 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 0.9392 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 56 mm (b_f)

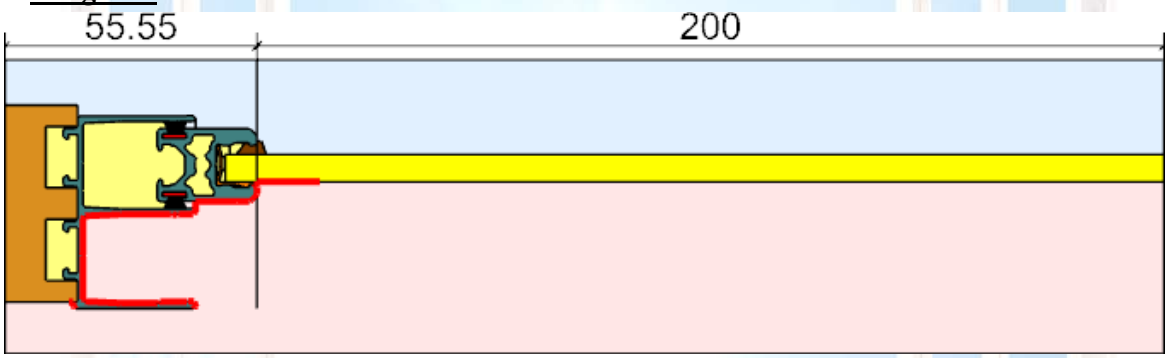
$$U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{0.9392 - 2.9289 \cdot 0.20000}{0.05555} = 6.4\ (6.3622) \frac{W}{m^2K}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external (SVC) 0.30; 0°C	0.300	0.000	-0.080
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-18.704
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	17.417
	Boundary condition internal 20°C 0.20	0.200	20.000	1.367

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	317.24	160.000	0.900
	3 PVC-U Hard	12.50	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.40	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.48	0.200	0.900
	5 brush seal	18.58	0.140	0.900
	5 EPDM	12.91	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	618.32

Image: Uf



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U_f-Value

$Q_{tot} = 20.503 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 1.0252 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 56 mm (b_f)

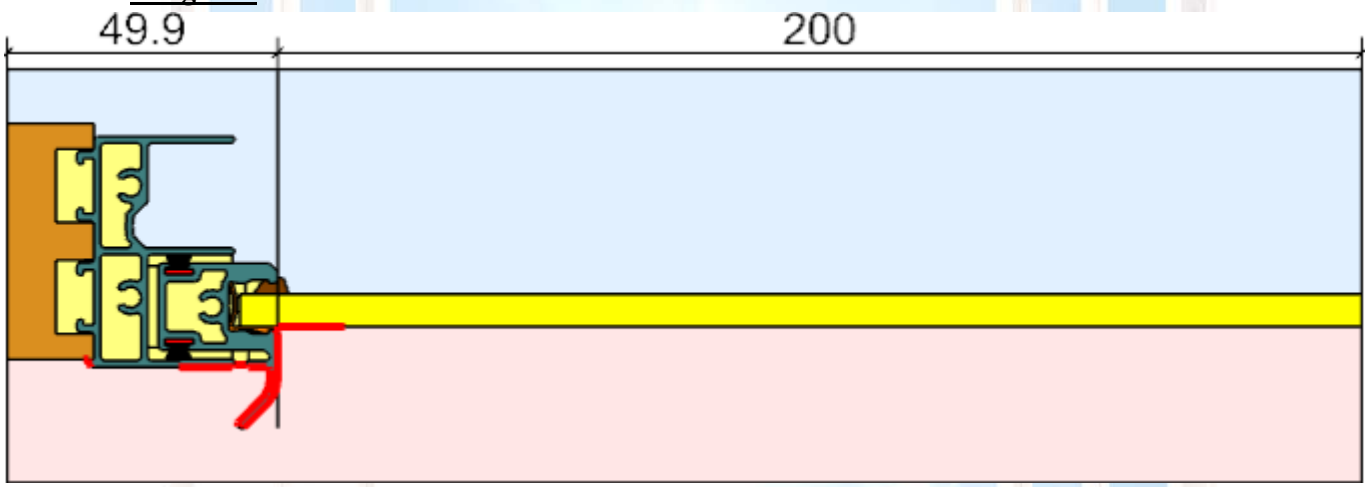
$$\mathbf{U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{1.0252 - 2.9289 \cdot 0.20000}{0.05555} = 7.9\ (7.9098) \frac{W}{m^2K}}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external (SVC) 0.30; 0°C	0.300	0.000	-0.141
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-20.362
	Boundary condition internal (SVC) 0.30; 20°C	0.300	20.000	0.307
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	14.030
	Boundary condition internal 20°C 0.20	0.200	20.000	6.165

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	317.93	160.000	0.900
	3 PVC-U Hard	12.50	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.40	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.57	0.200	0.900
	5 brush seal	19.95	0.140	0.900
	5 EPDM	12.91	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	608.26

Image: Uf



U_f-Value

$Q_{tot} = 19.282 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 0.9641 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 50 mm (b_f)

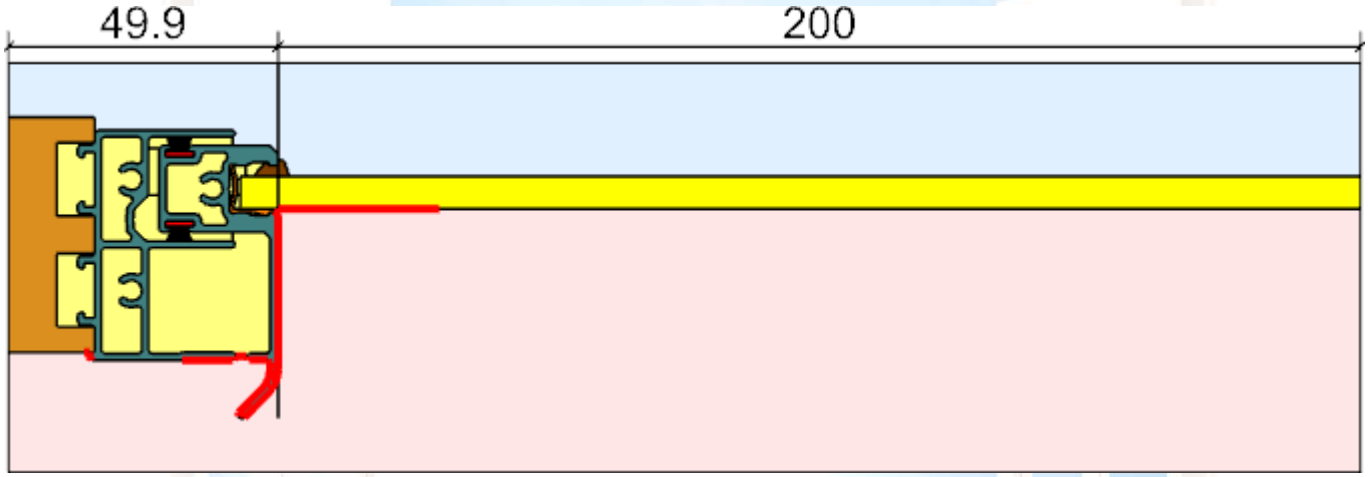
$$U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{0.9641 - 2.9289 \cdot 0.20000}{0.04990} = 7.6\ (7.5821) \frac{W}{m^2K}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-19.282
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	14.429
	Boundary condition internal 20°C 0.20	0.200	20.000	4.853

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	413.94	160.000	0.900
	3 PVC-U Hard	12.50	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.40	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.60	0.200	0.900
	5 brush seal	19.82	0.140	0.900
	5 EPDM	12.91	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	625.95

Image: Uf



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U_f-Value

$Q_{tot} = 18.997 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 0.9498 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 50 mm (b_f)

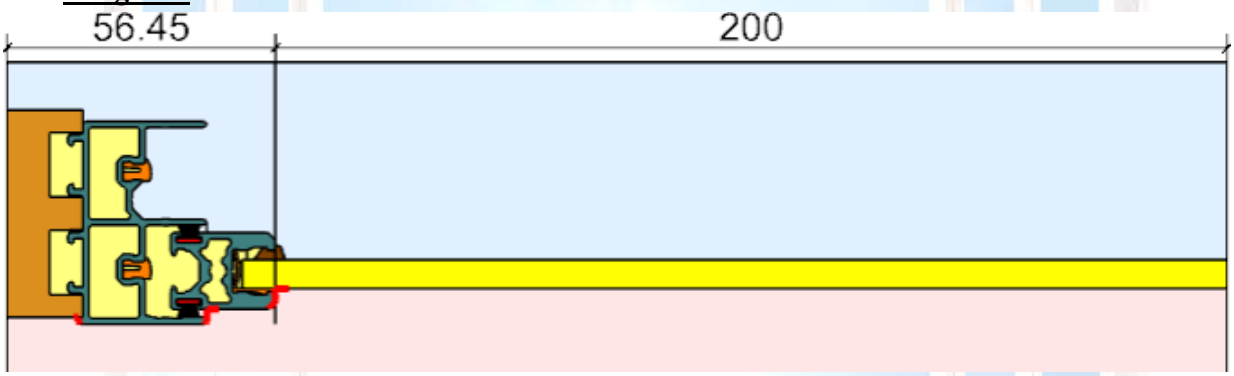
$$\mathbf{U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{0.9498 - 2.9289 \cdot 0.20000}{0.04990} = 7.3\ (7.2960) \frac{W}{m^2K}}$$

	Boundaries	**R [m²K/W]**	**T [°C]**	**Qges [W/m]**
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-18.997
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	12.847
	Boundary condition internal 20°C 0.20	0.200	20.000	6.150

	Solids	**A [mm²]**	**λ [W/(mK)]**	**ε [-]**
	3 alu (Si-Leg.) 160	444.00	160.000	0.900
	3 PVC-U Hard	12.52	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.60	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.60	0.200	0.900
	5 brush seal	19.01	0.140	0.900
	5 EPDM	12.32	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	**A [mm²]**
	Unventilated air cavity - EN ISO 10077-2	1084.06

Image: Uf



U_f-Value

$Q_{tot} = 18.951 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 0.9476 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 56 mm (b_f)

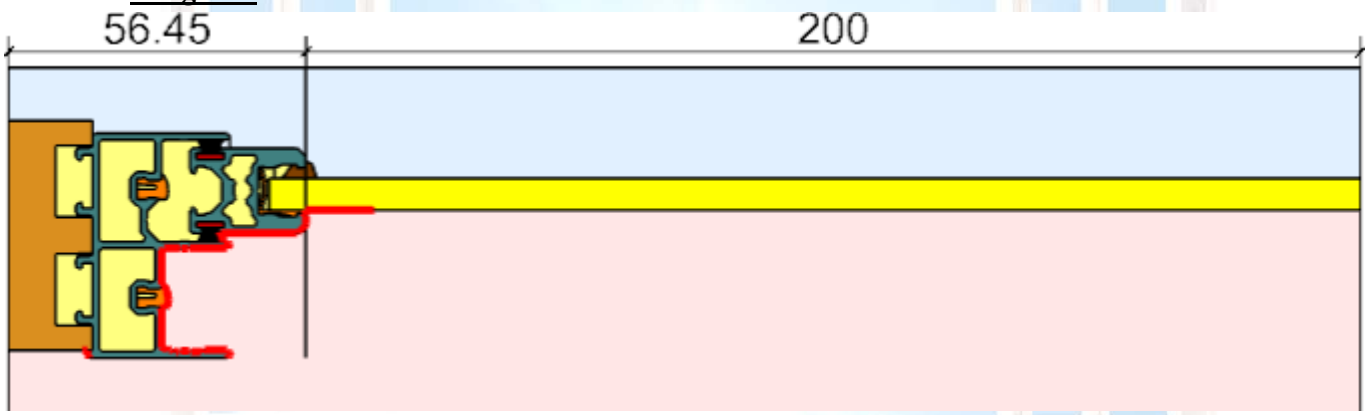
$$U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{0.9476 - 2.9289 \cdot 0.20000}{0.05645} = 6.4\ (6.4090) \frac{W}{m^2K}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external (SVC) 0.30; 0°C	0.300	0.000	-0.069
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-18.883
	Boundary condition internal (SVC) 0.30; 20°C	0.300	20.000	0.352
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	17.461
	Boundary condition internal 20°C 0.20	0.200	20.000	1.137

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	381.40	160.000	0.900
	3 PVC-U Hard	49.90	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.40	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.31	0.200	0.900
	5 brush seal	19.14	0.140	0.900
	5 EPDM	12.91	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	742.39

Image: Uf



U_f-Value

$Q_{tot} = 19.959 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 0.9979 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 56 mm (b_f)

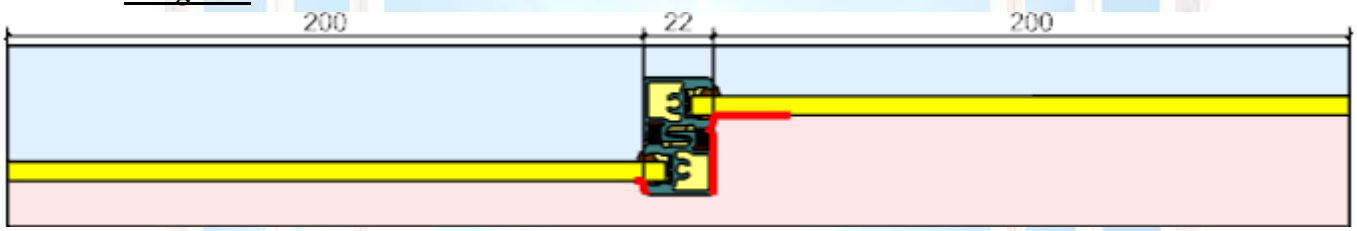
$$U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{0.9979 - 2.9289 \cdot 0.20000}{0.05645} = 7.3\ (7.3013) \frac{W}{m^2K}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external (SVC) 0.30; 0°C	0.300	0.000	-0.124
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-19.834
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	14.395
	Boundary condition internal 20°C 0.20	0.200	20.000	5.564

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	382.14	160.000	0.900
	3 PVC-U Hard	49.90	0.170	0.900
	3 softwood Rd = 500 kg / m³	504.40	0.130	0.900
	4 ABS (acrylic-butadiene-styrene)	10.59	0.200	0.900
	5 brush seal	19.54	0.140	0.900
	5 EPDM	12.91	0.250	0.900
	Replacement panel EN ISO 10077-2	1242.00	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	757.60

Image: Uf



U_f-Value

$Q_{tot} = 27.981 \frac{W}{m}$ $\Delta T = 20$ K $L_{2D} = \frac{Qtot}{\Delta T} = 1.3990 \frac{W}{m \cdot K}$

$U_p = 2.929 \frac{W}{m \cdot K}$ Width of panel = 200 mm (b_p) Width of frame = 22 mm (b_f)

$$U_f = \frac{L2D - Up \cdot bp}{bf} = \frac{1.3990 - 2.9289 \cdot 0.20000 - 2.9289 \cdot 0.20000}{0.02200} = 10\ (10.3401) \frac{W}{m^2K}$$

	Boundaries	R [m²K/W]	T [°C]	Qges [W/m]
	Boundary condition external 0.04, 0°C, 80%	0.040	0.000	-27.981
	Boundary condition internal 0.13, 20°C, 50%	0.130	20.000	24.129
	Boundary condition internal 20°C 0.20	0.200	20.000	3.852

	Solids	A [mm²]	λ [W/(mK)]	ε [-]
	3 alu (Si-Leg.) 160	316.40	160.000	0.900
	3 PVC-U Hard	25.02	0.170	0.900
	4 ABS (acrylic-butadiene-styrene)	10.60	0.200	0.900
	5 brush seal	38.05	0.140	0.900
	5 EPDM	25.86	0.250	0.900
	Replacement panel EN ISO 10077-2	2482.94	0.035	0.900

	Cavities	A [mm²]
	Unventilated air cavity - EN ISO 10077-2	303.19