

Vertical Sliding Sash Window Thermal Performance (U value) Calculation Report

Commissioned by: -

Timber Products Direct Ltd
3 Coombe Pine
Bracknell
RG12 0TJ

Report prepared by: -

Dr Gary Morgan
Therm Consulting Ltd

21st August 2014



Thermal Simulation
HVAC Modelling and Simulation
Engineering
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THERMAL SIMULATION REPORT

Report Number:	TCL2014-TPD-001
Prepared For:	Timber Products Direct Ltd 3 Coombe Pine Bracknell RG12 0TJ
Window System Identifier:	Timber Vertical Sliding Sash
Head Rail Identifier	Head Rail
Upper Jamb Identifier	Upper Jamb
Meeting Rail Identifier	Meeting Rail
Lower Jamb Identifier	Lower Jamb
Sill Identifier	Sill
Glazing System	4mm Clear Float – 16mm 90% Argon – 4mm Thermofloat
Spacer Bar	15.5 mm TGI Spacer M
Notes:	See enclosed drawings for critical frame dimensions. Frame can be made either from Meranti hardwood or softwood

Results

Thermal Transmittance (U_{window})	1.5	W/(m ² K)
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(Window Configuration as per GGF Document 2.2)
(1230mm wide x 1480mm high –vertical sliding sash)

Report Prepared By Dr Gary Morgan
Therm Consulting Ltd.

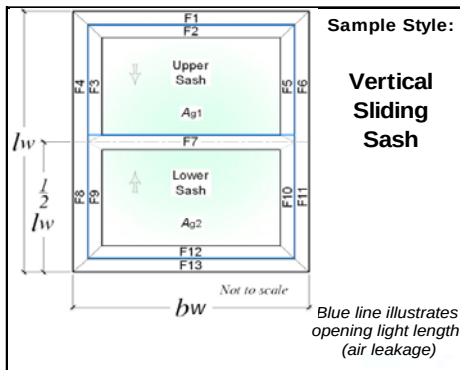
Signed: 

Date: 21st August 2014

The simulations in this report were performed using Win Iso 2D Pro version 7.57, strictly in accordance with the requirements of EN ISO 10077-2:2012
The simulation files generated are attached to this report as appendices



**BFRC Certified
Simulator 016**



Report Number: **TCL2014-TPD001**
 Report Date: **21/08/2014**

Report Issue No.15.1 (11/03/13)

Project Details: **Meranti or softwood VS with 4 16 4 glazing - Ug = 1.1**
TGI M Spacer

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Input Values:
 Yellow input, green intermediary, blue finals X DP is no. of decimal place to enter

Parameter	Symbol	Units
Total window height 0DP	l_w	1480 mm
Total window width 0DP	b_w	1230 mm

Frame offset: **No**

Nominal 4mm etc to 0DP , others 1DP		
Glazing dimensions and properties:		
Thickness of pane 1, d_1	4.0	mm
Glazing fill thickness 1/2, d_{12}	16.0	mm
Gas fill (1/2)	Argon 90%	
Thickness of pane 2, d_2	4.0	mm
Complete next 3 cells for TG IGU		
Glazing fill thickness 2/2, d_{22}		mm
Gas fill (2/3)		
Thickness of pane 3, d_3		mm
Glazing Trans. - 3DP	U_g 1.100	W/(m ² ·K)
g-value - 2DP	g 0.7	

Thermal transmittance of window from hot box test
 U_w - **2DP** W/(m²·K)

Window Dimensions:			Area, A	
Section	Length, l	Width, b	No gasket	With gasket
	m	m	m ²	m ²
Upper glazing	0.5750	0.9760	0.5612	0.5550
Lower glazing	0.5850	0.9760	0.5710	0.5647
Total of glazing			1.1322	1.1197
Frame	m	m	m ²	m ²
F1	1.2300	0.0980	0.1177	0.1177
F2	1.1720	0.0380	0.0408	0.0428
F3	0.6420	0.0980	0.0596	0.0608
F4	0.7400	0.0290	0.0200	0.0200
F5	0.6420	0.0980	0.0596	0.0608
F6	0.7400	0.0290	0.0200	0.0200
F7	1.1720	0.0580	0.0623	0.0662
F8	0.7400	0.0290	0.0203	0.0203
F9	0.6610	0.0980	0.0611	0.0622
F10	0.6610	0.0980	0.0611	0.0622
F11	0.7400	0.0290	0.0203	0.0203
F12	1.1720	0.0470	0.0505	0.0524
F13	1.2300	0.0790	0.0949	0.0949
Total Frame			0.6882	0.7007
Total Window, A_w			1.8204	1.8204
Percentage upper glass area			30.83%	30.49%
Percentage lower glass area			31.36%	31.02%
Percentage glass area (total)			62.19%	61.51%

Solar Factor, g-value:	glazing area A_g (m ²)	1.1810
	F_w	0.9
	g_w	0.00

U_{window}	No bars; or attached bars	1.54	W/(m ² ·K)
	Single cross bar in IGU	1.6	
	Multiple cross bar in IGU	1.7	
	Glazing bar (Georgian bar)	1.9	

BFRC Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
≥10	N/A	A+	N/A
0 to <10		A	
-10 to <0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50	F		

Frame dimensions (All frame values to 0dp, gaskets to 1DP)	Frame height, b_f (mm)		Gasket protrusion (mm)	With gasket (mm)	Total
	Internal	External			
F1 fixed top rail	98	98	n/a	98.0	138.0
F2 moving top rail	38	38	2.0	40.0	
F3 top (LH) jamb (moving sash)	98	98	2.0	100.0	129.0
F4 top (LH) jamb (fixed frame)	29	29	n/a	29.0	
F5 top (RH) jamb (moving sash)	98	98	2.0	100.0	
F6 top (RH) jamb (fixed frame)	29	29	n/a	29.0	129.0
F7 mid rail (upper)	58		2.0	62.0	62.0
F7 mid rail (lower)			2.0		
F8 bottom (LH) jamb (fixed frame)	29	29	n/a	29.0	
F9 bottom (LH) jamb (moving sash)	98	98	2.0	100.0	129.0
F10 bottom (RH) jamb (moving sash)	98	98	2.0	100.0	
F11 bottom (RH) jamb (fixed frame)	29	29	n/a	29.0	129.0
F12 bottom moving rail	47		2.0	49.0	
F13 bottom fixed rail	79		n/a	79.0	128.0
Total gasket area			0.012416	m ²	

Where a U_w value from hot box testing is available, n_d , r or L_{ψ} values need to be entered					
All L values to 4DP . All b values to 0DP					
Frame conductance:	$W/(m^2 \cdot K)$	b_p (mm)	$W/(m^2 \cdot K)$	b_p (mm)	
F1+F2 top rail	0.4330	190	0.4820	190	
F3+F4 top (LH) jamb	0.4170	190	0.4650	190	
F5+F6 top (RH) jamb	0.4170	190	0.4650	190	
F7 mid rail	0.6070	380	0.7010	380	
F8+F9 bottom (LH) jamb	0.4230	190	0.4720	190	
F10+F11 bottom (RH) jamb	0.4230	190	0.4720	190	
F12+F13 bottom rail	0.4480	190	0.4990	190	

Frame:	Frame width, b_r	Frame U-value, U	Frame areas, A	Frame heat flow, H_U	Linear trans, ψ	Linear length, l_p	Junction heat flow, H_{ψ}
	m	W/(m ² ·K)	m ²	W/K	W/(m·K)	m	W/K
F1+F2 top rail	0.1360	1.5512	0.1585	0.2459	0.0620	0.9760	0.0605
F3+F4 top left jamb	0.1270	1.5351	0.0797	0.1223	0.0610	0.5750	0.0351
F5+F6 top right jamb	0.1270	1.5351	0.0797	0.1223	0.0610	0.5750	0.0351
F7 mid rail	0.0580	2.8091	0.0623	0.1750	0.1201	0.9760	0.1172
F8+F9 btm left jamb	0.1270	1.5824	0.0814	0.1288	0.0620	0.5850	0.0363
F10+F11 btm right jamb	0.1270	1.5824	0.0814	0.1288	0.0620	0.5850	0.0363
F12+F13 bottom rail	0.1260	1.7934	0.1454	0.2607	0.0640	0.9760	0.0625
Totals		0.6882	1.1837			Total	0.3830

Air Leakage loss:		
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) 2DP		
Opening light length, $l_{opening}$	6.2480 m	Total air leakage 0.000 m ³ /h
L_{50}	0.00 m ³ /(m ² ·h)	Heat loss = 0.0165 L_{50} 0.00 W/(m ² ·K)

Other parameters needed for calculation, taken from simulations:			
λ_p = 0.035	W/(m·K)	R_{se} = 0.04	m ² ·K / W
R_p = 0.6857	m ² ·K / W	R_{tot} = 0.8557	m ² ·K / W
$d_p = d_g$ = 0.024	m	R_{se} = 0.13	m ² ·K / W
U_p = 1.1686	W/(m ² ·K)		

BFRC Rating =	
218.6g_{window} - 68.5 × (U_{window} + Effective L₅₀) =	N/A
Climate zone is:	UK

Thermal transmittance, W/(m²·K)	U_{window} 1.5
Solar factor	g_{window} N/A
Window air leakage heat loss, W/(m²·K)	L_{factor} N/A

Simulator Name: **Dr Gary Morgan**



BFRC Certified Simulator **016**

	Producent <i>Producer</i> Press-Glas SA Nowa Wieś, ul. Kopalniana 9 42-262 Poczesna POLAND	Zakład produkcyjny/Production factory Press-Glas SA Nowa Wieś ul. Kopalniana 9; 42-262 Poczesna Press-Glas SA Oddział w Tychach ul. Cielmicka 44; 43-100 Tychy Press-Glas SA Oddział w Tczewie ul. Skarszewska 11; 83-110 Tczew POLAND		Jednostka notyfikowana/ Notified Body IFT Rosenheim Nr/No 0757 Theodor-Gietl-Straße 7-9 83026 Rosenheim; GERMANY	Rok wprowadzenia Year of issue 07	
Deklaracja Zgodności Declaration of Conformity	Nr/No. 72 I	Press-Glas SA deklaruje na wyłączną odpowiedzialność, poniższe parametry wyrobu o nazwie Press-Glas SA declare, under its sole responsibility, the following characteristics of the glass product named				
zgodnie z wymogami normy under requirements of standard	EN 1279-5	Float 4mm/16/Thermofloat 4mm Argon ** Izolacyjna szyba zespolona przeznaczona do stosowania w budynkach i pracach budowlanych. Insulating glass unit, intended to be used in buildings and construction works.				
Właściwości		Characteristics	Symbol	Jednostka Unit of meas.	Norma Standard	Wartość Value
Ognioodporność		Resistance to fire		-	EN-13501-2	NPD
Reakcja na ogień		Reaction to fire		-	EN-13501-1	NPD
Działanie ognia zewnętrznego		Behaviour of external fire		-	-	NPD
Odporność na uderzenie pocisku		Bullet resistance		-	EN 1063	NPD/NPD *
Odporność na wybuch		Resistance to explosion		-	EN 13541	NPD/NPD *
Odporność przeciwbłamniowa		Resistance to burglary		-	EN 356	NPD/NPD *
Odporność na wstrząsy i uderzenia ciała		Resistance to pendulum body impact		-	EN 12600	NPD/NPD *
Odporność na nagłe zmiany temperatury i na różnice temperatur		Resistance to sudden temperature change and temperature differentials		[°K]	EN 572	40/40 *
Odporność na wiatr, śnieg oraz obciążenie trwałe i przyłożone		Resistance to wind, snow, permanent or imposed load		[mm]	-	4/4 *
Bezpośrednia izolacyjność od dźwięków powietrznych		Direct airborne sound reduction	R _w (C ₅₀ , C _{50w})	[dBA]	EN 12758	31 (-2; -5)
Właściwości cieplne - Współczynnik przenikania ciepła		Thermal properties - Thermal transmittance factor	U	[W/m²K]	EN 673 EN 674	1,1 1,0
Świetlne właściwości promieniowania		Light properties of radiation				
Współczynnik przepuszczalności światła		Light transmittance factor	T _v (L _T)	[%]	EN 410	78-80
Współczynnik odbicia światła		Light reflectance factor	P _v (L _R) P' _v (L' _R)	[%]	EN 410	12-14 12-15
Właściwości promieniowania energii świetlnej		Light energy radiation properties				
Współczynnik przepuszczalności bezpośredniej promieniowania słonecznego		Solar direct transmittance factor	τ _e (E _T)	[%]	EN 410	51-64
Współczynnik odbicia bezpośredniego promieniowania słonecznego		Solar direct reflectance factor	ρ _s (E _R) ρ' _s (E' _R)	[%]	EN 410	28-36 27-32
Współczynnik całkowitej przepuszczalności energii promieniowania słonecznego		Total solar energy transmittance factor	g	[%]	EN 410	60-63

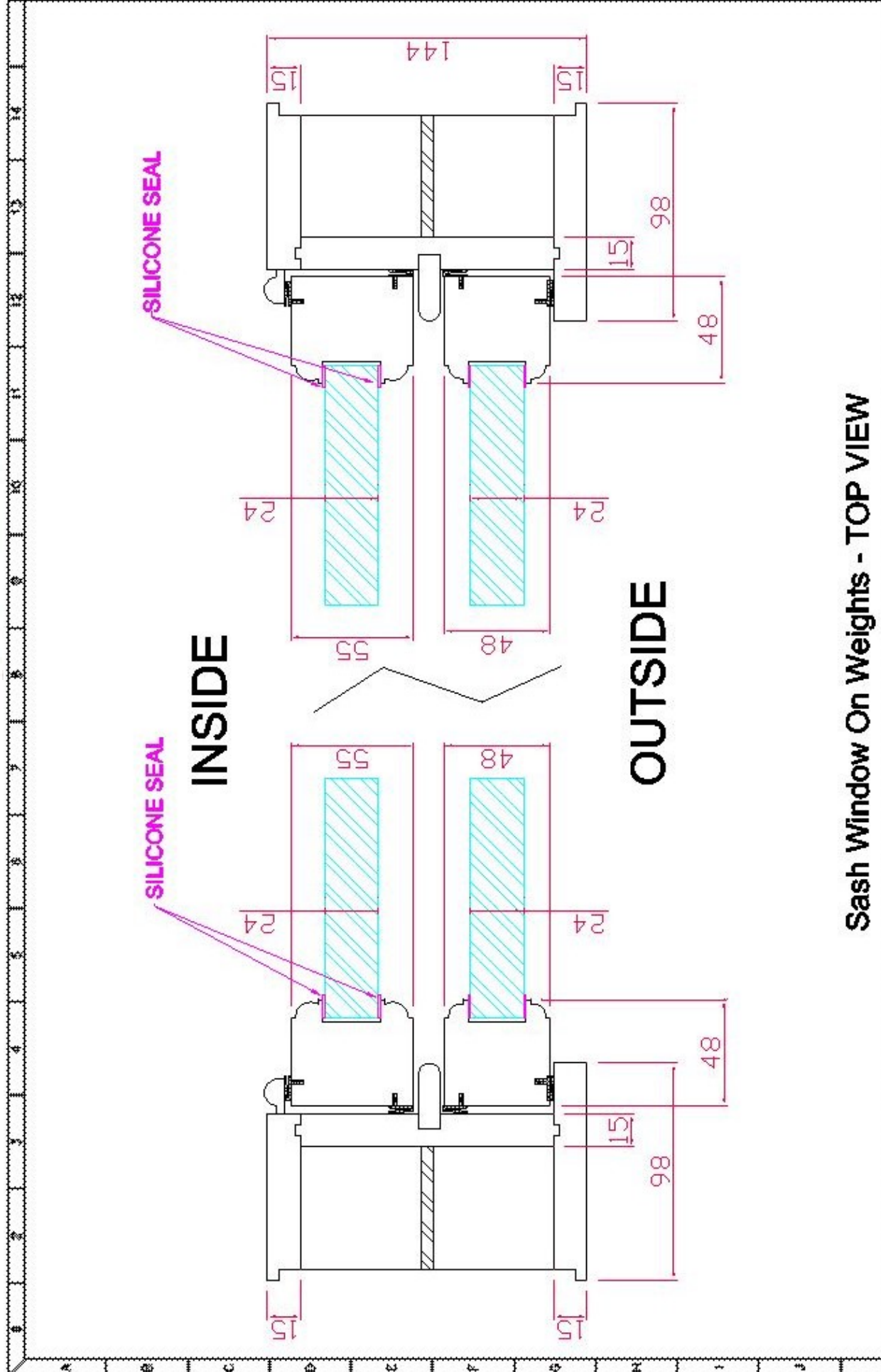
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NPD - Właściwość użytkowa nie oznaczona/No performance determined; * - Wartość podana dla kolejnych szyb w zestawie/Value given for each pane in glass unit; ** - uwzględnia wszystkie rodzaje ramek dystansowych/include all types of spacerbar used

Źródło/Source: www.press-glas.com/pl

M. Radomski

Mirosław Radomski
Wiceprezes Zarządu / Vice Chairman



Sash Window On Weights - TOP VIEW

Tel 01440 709083 E-mail designsolutions@outlook.com 3D & 2D Drafting & Design Services	DESIGNER: JAMES PROBERTS DIRECTOR DATE: 01/01/2024 PROJECT: SASH WINDOW ON WEIGHTS	PROJECT: SASH WINDOW ON WEIGHTS DATE: 01/01/2024 PROJECT: SASH WINDOW ON WEIGHTS
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Simulation software: WinIso2D 7.92

Date: 21.08.2014

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Files\Timber Products Direct\Bottom Jamb.f2d

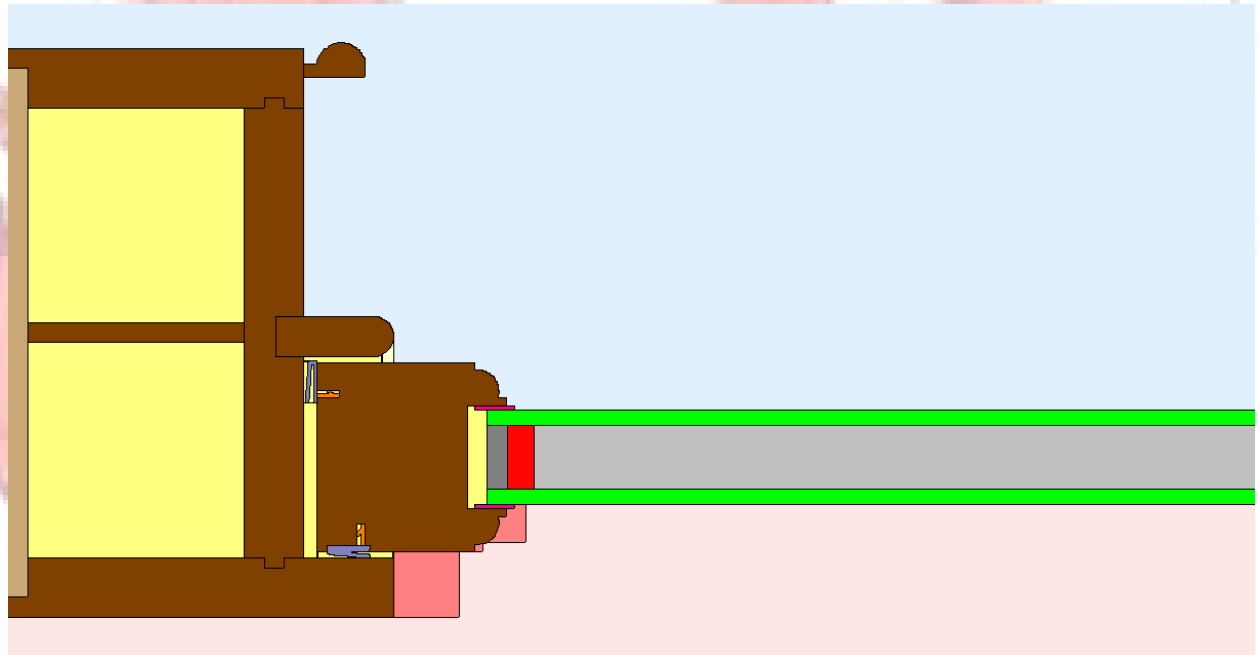


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 316,50 x 165,52 mm

Number of elements in simulation model: X-direction: 265; Y-direction: 206



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 9,446 W/m

2D thermal conductance L_{2D} : 0,472 W/mK

Length top/left: 190,00 mm

U-value top/left: 1,100 W/m²K

Length bottom/right: 0,00 mm

U-value bottom/right: 0,000 W/m²K

Ψ -value: 0,063 W/mK

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,446	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	7,854	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	1,591	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
2 Softwood	0,130	0,900		X
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
020 Technoform Glass Insulation	0,310	0,900		-
TGI-M 2013-10, 6,9 mm				
6 polysulfide	0,400	0,900		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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Files\Timber Products Direct\Bottom Jamb.f2d

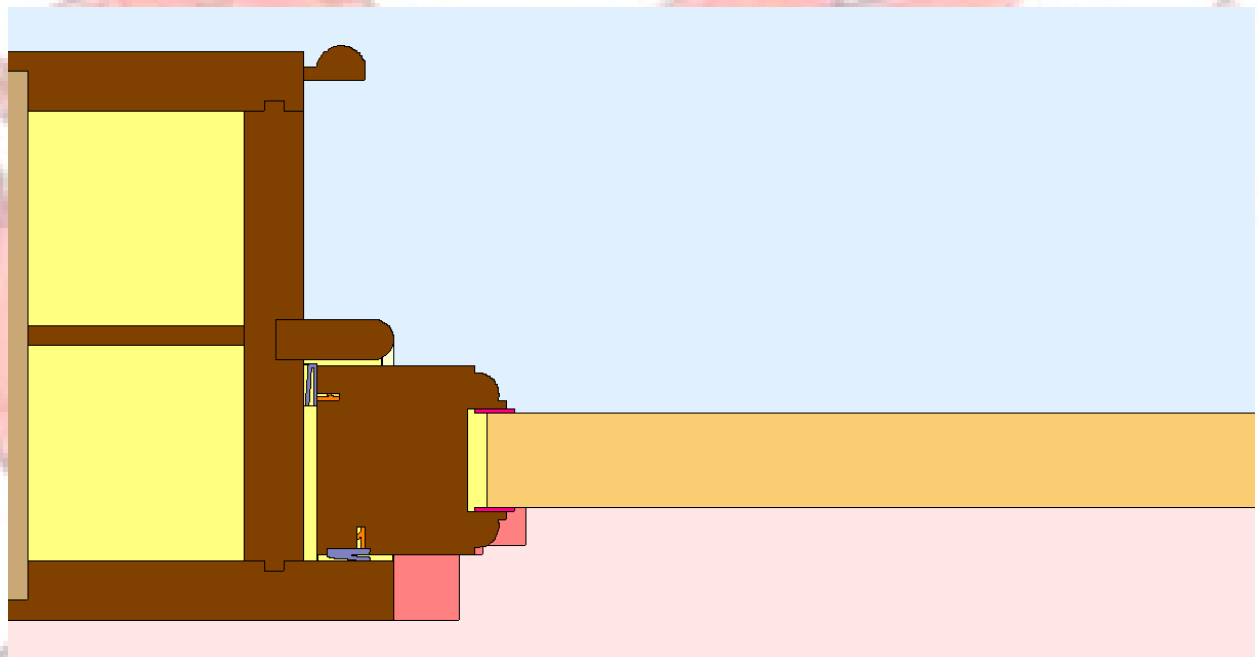


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 316,50 x 165,52 mm

Number of elements in simulation model: X-direction: 265; Y-direction: 206



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 8,451 W/m

2D thermal conductance L_{2D} : 0,423 W/mK

Length 1: 190,00 mm

U-value 1: 1,169 W/m²K

Length 2: 0,00 mm

U-value 2: 0,000 W/m²K

U_f -value: 1,585 W/m²K

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,446	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	7,854	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	1,591	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
2 Softwood	0,130	0,900		X
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
020 Technoform Glass Insulation	0,310	0,900		-
TGI-M 2013-10, 6,9 mm				
6 polysulfide	0,400	0,900		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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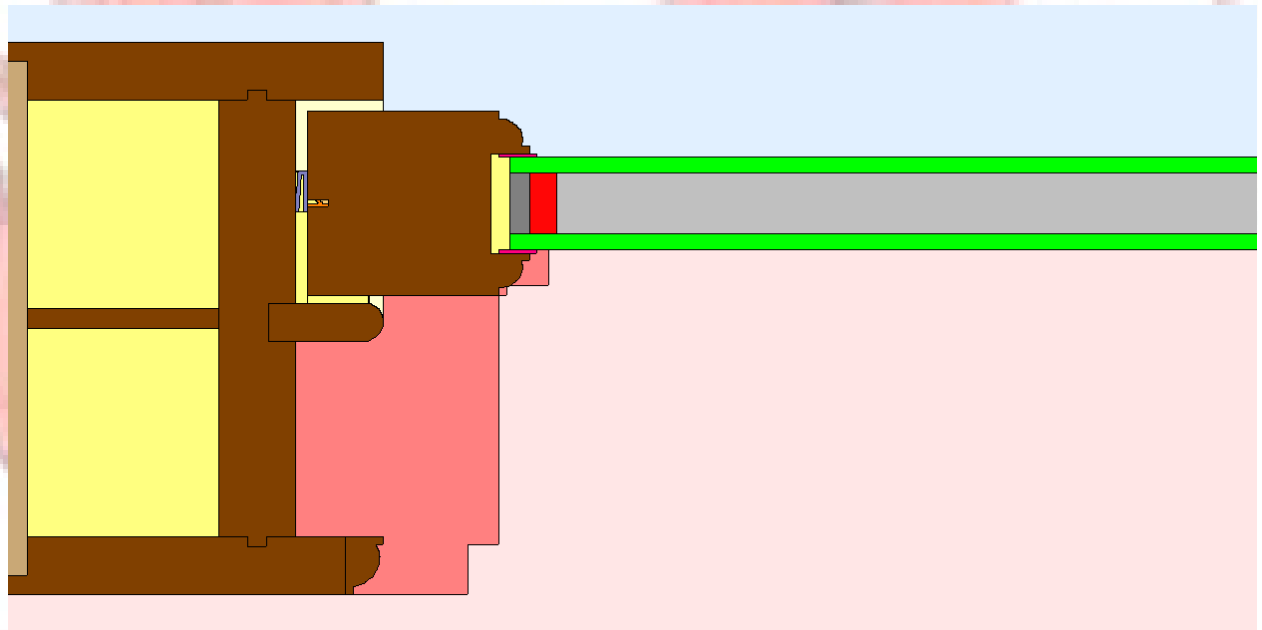


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 326,00 x 164,00 mm

Number of elements in simulation model: X-direction: 260; Y-direction: 197



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference ΔT : 20,00 K

Total heat flow Q : 9,649 W/m

2D thermal conductance L_{2D} : 0,482 W/mK

Length top/left: 190,00 mm

U-value top/left: 1,100 W/m²K

Length bottom/right: 0,00 mm

U-value bottom/right: 0,000 W/m²K

Ψ -value: 0,062 W/mK

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,649	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	6,085	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,563	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
2 Softwood	0,130	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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Files\Timber Products Direct\Head.f2d

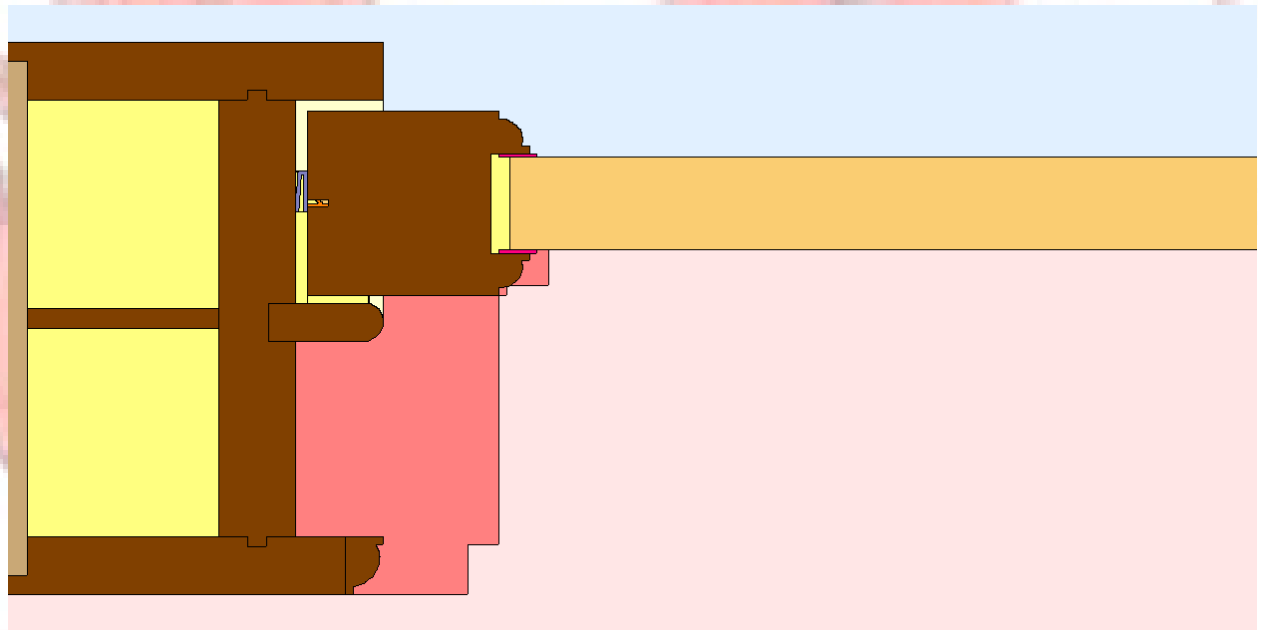


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 326,00 x 164,00 mm

Number of elements in simulation model: X-direction: 260; Y-direction: 197



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 8,669 W/m

2D thermal conductance L_{2D} : 0,433 W/mK

Length 1: 190,00 mm

U-value 1: 1,169 W/m²K

Length 2: 0,00 mm

U-value 2: 0,000 W/m²K

U_f -value: 1,554 W/m²K

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,649	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	6,085	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,563	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
2 Softwood	0,130	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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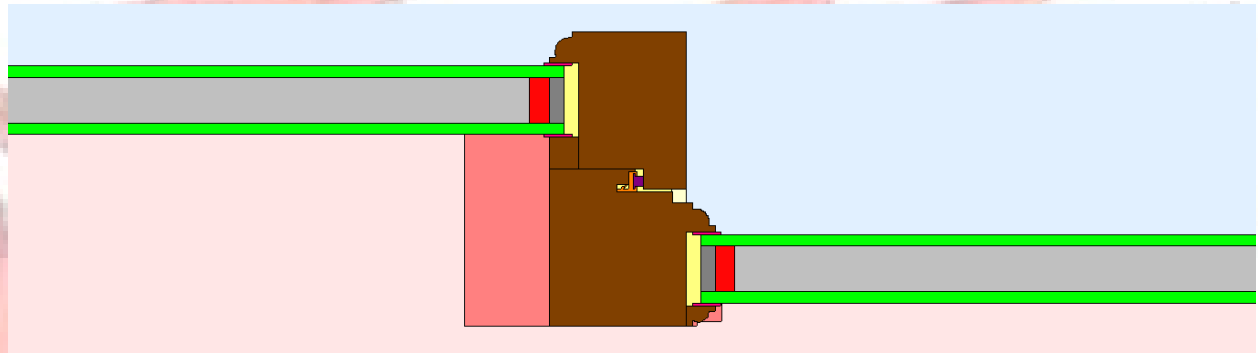


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 438,00 x 123,00 mm

Number of elements in simulation model: X-direction: 277; Y-direction: 131



Boundary conditions:

External:

Temperature Θ_e :	0,00	°C
Surface resistance R_{se} :	0,040	m ² K/W

Internal:

Temperature Θ_i :	20,00	°C
Surface resistance R_{si} 1:	0,130	m ² K/W
Surface resistance R_{si} 2:	0,200	m ² K/W

Results:

Temperature difference ΔT :	20,00	K
Total heat flow Q :	14,023	W/m
2D thermal conductance L_{2D} :	0,701	W/mK

Length top/left:	190,00	mm
U-value top/left:	1,100	W/m ² K

Length bottom/right:	190,00	mm
U-value bottom/right:	1,100	W/m ² K

Ψ -value:	0,120	W/mK
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Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-14,023	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	10,418	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,606	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-
5 Brush Pile Woven	0,140	0,900		X

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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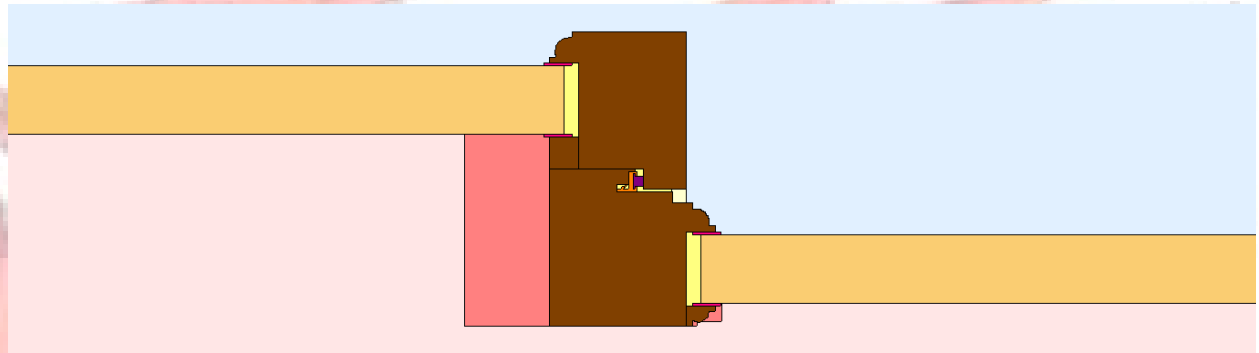


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 438,00 x 123,00 mm

Number of elements in simulation model: X-direction: 277; Y-direction: 131



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 12,149 W/m

2D thermal conductance L_{2D} : 0,607 W/mK

Length 1: 190,00 mm

U-value 1: 1,169 W/m²K

Length 2: 190,00 mm

U-value 2: 1,169 W/m²K

U_f -value: 2,814 W/m²K

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-14,023	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	10,418	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,606	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-
5 Brush Pile Woven	0,140	0,900		X

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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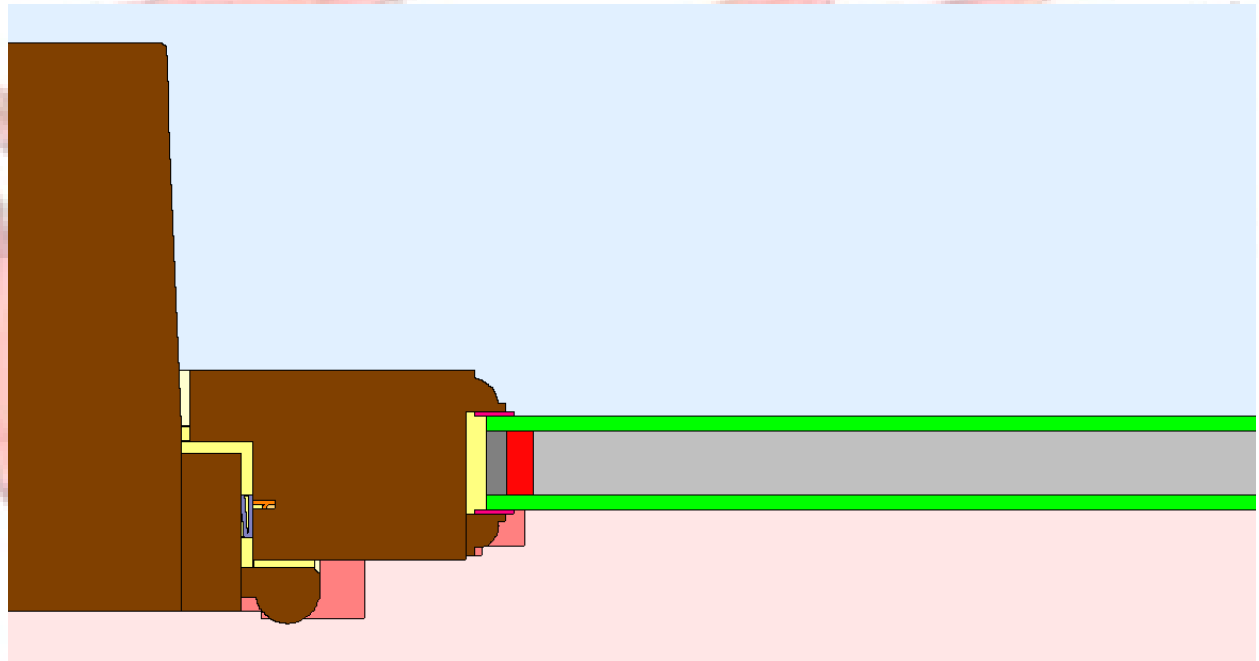


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 316,00 x 167,18 mm

Number of elements in simulation model: X-direction: 272; Y-direction: 208



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 9,971 W/m

2D thermal conductance L_{2D} : 0,499 W/mK

Length top/left: 190,00 mm

U-value top/left: 1,100 W/m²K

Length bottom/right: 0,00 mm

U-value bottom/right: 0,000 W/m²K

Ψ -value: 0,063 W/mK

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,971	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	8,309	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	1,663	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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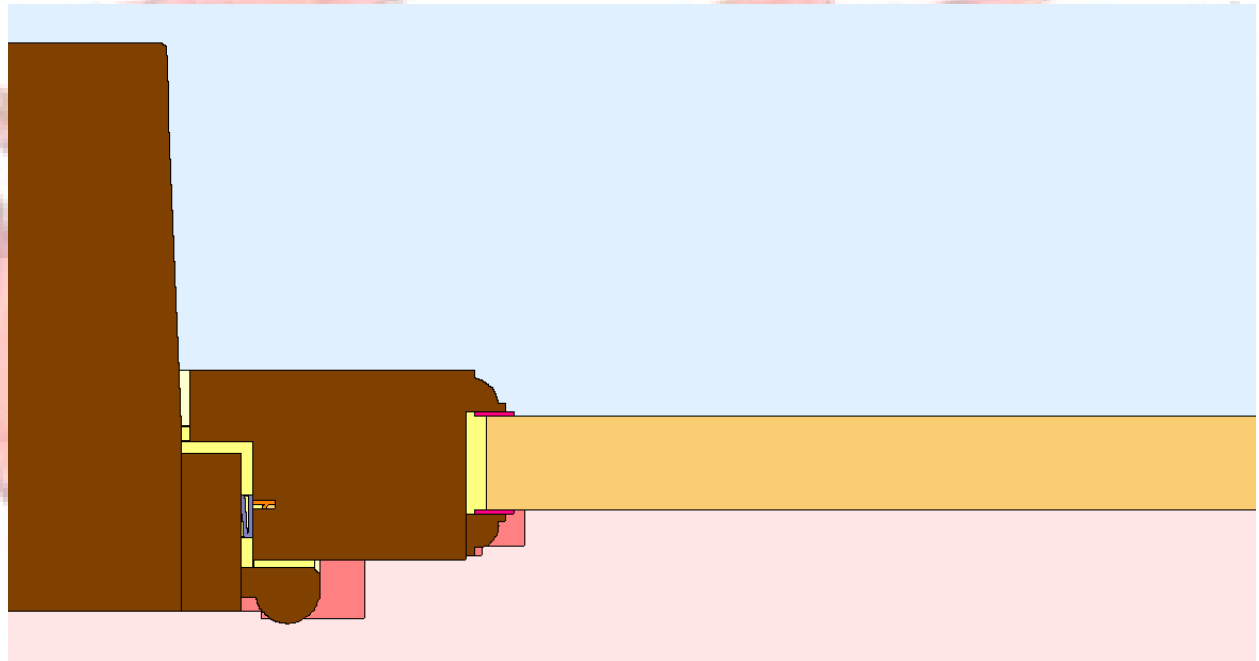


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 316,00 x 167,18 mm

Number of elements in simulation model: X-direction: 272; Y-direction: 208



Boundary conditions:

External:

Temperature Θ_e :	0,00	°C
Surface resistance R_{se} :	0,040	m ² K/W

Internal:

Temperature Θ_i :	20,00	°C
Surface resistance R_{si} 1:	0,130	m ² K/W
Surface resistance R_{si} 2:	0,200	m ² K/W

Results:

Temperature difference dT :	20,00	K
Total heat flow Q :	8,964	W/m
2D thermal conductance L_{2D} :	0,448	W/mK

Length 1:	190,00	mm
U-value 1:	1,169	W/m ² K

Length 2:	0,00	mm
U-value 2:	0,000	W/m ² K

U_f -value:	1,794	W/m ² K
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Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,971	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	8,309	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	1,663	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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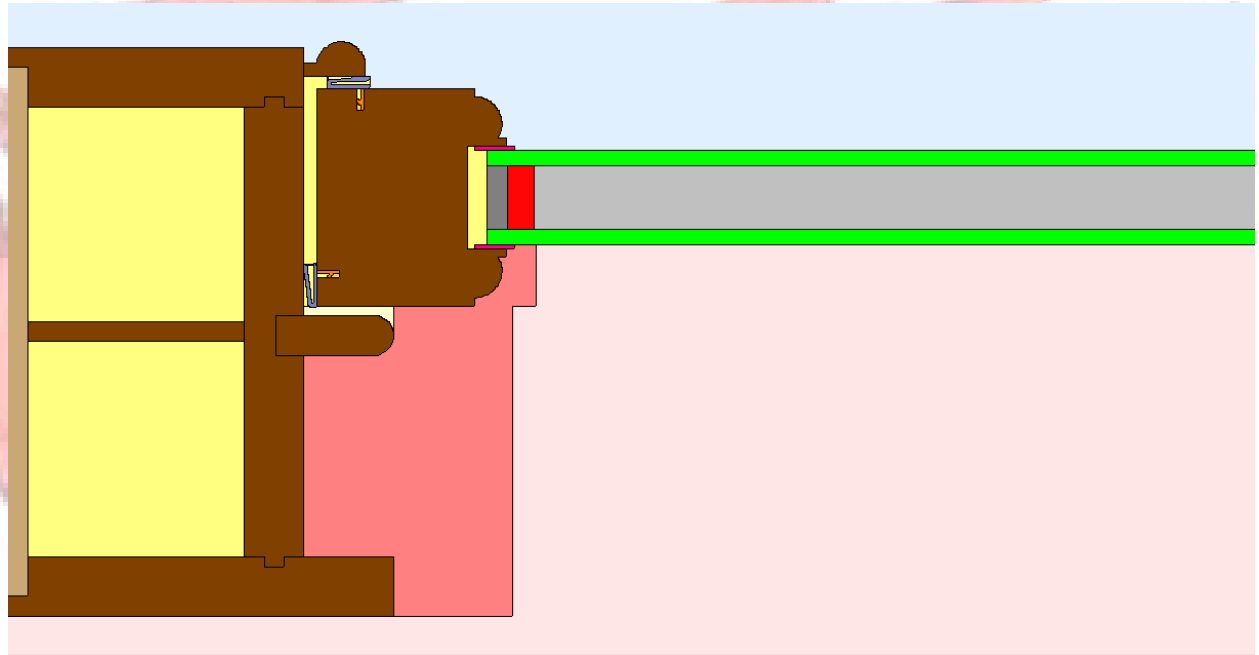


Calculation of the linear thermal transmission coefficient Ψ according to EN ISO 10077-2

Simulation model:

Dimensions (width x height): 316,50 x 165,52 mm

Number of elements in simulation model: X-direction: 271; Y-direction: 209



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference dT : 20,00 K

Total heat flow Q : 9,297 W/m

2D thermal conductance L_{2D} : 0,465 W/mK

Length top/left: 190,00 mm

U-value top/left: 1,100 W/m²K

Length bottom/right: 0,00 mm

U-value bottom/right: 0,000 W/m²K

Ψ -value: 0,061 W/mK

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,297	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	5,898	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,399	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-
2 Softwood	0,130	0,900		X

Simulation software: WinIso2D 7.92

Date: 21.08.2014

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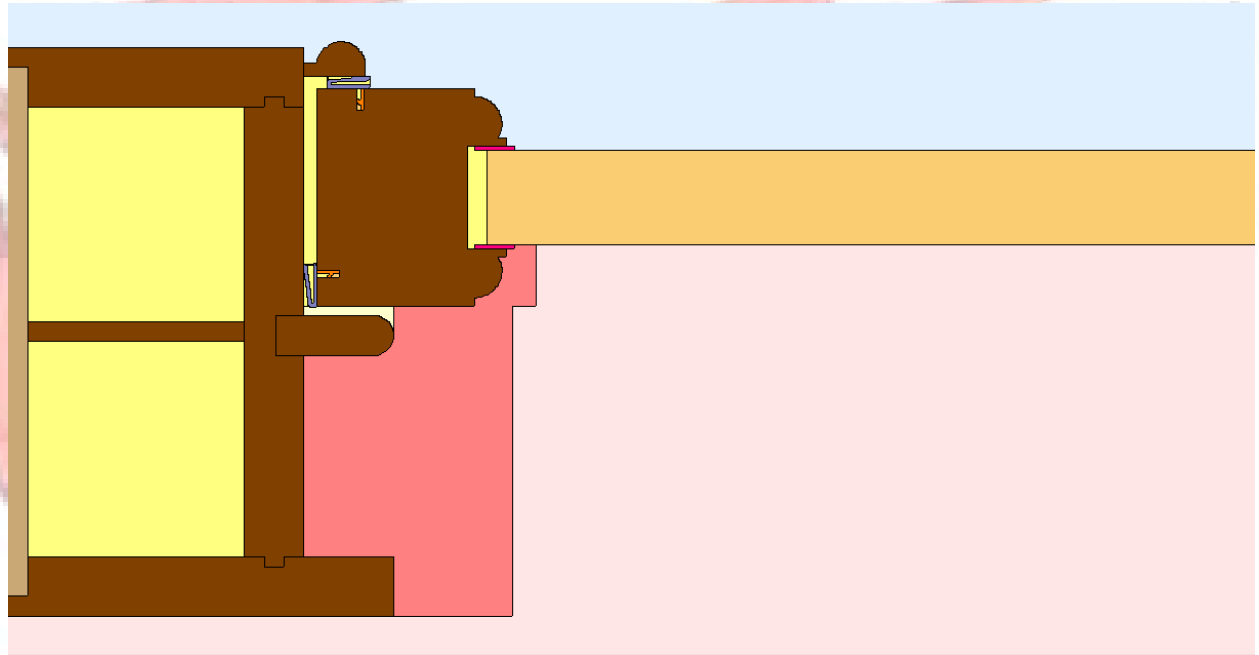


Calculation of the thermal transmission coefficient U_f according to EN ISO 10077-2:2003-12

Simulation model:

Dimensions (width x height): 316,50 x 165,52 mm

Number of elements in simulation model: X-direction: 271; Y-direction: 209



Boundary conditions:

External:

Temperature Θ_e : 0,00 °C

Surface resistance R_{se} : 0,040 m²K/W

Internal:

Temperature Θ_i : 20,00 °C

Surface resistance R_{si} 1: 0,130 m²K/W

Surface resistance R_{si} 2: 0,200 m²K/W

Results:

Temperature difference ΔT : 20,00 K

Total heat flow Q : 8,344 W/m

2D thermal conductance L_{2D} : 0,417 W/mK

Length 1: 190,00 mm

U-value 1: 1,169 W/m²K

Length 2: 0,00 mm

U-value 2: 0,000 W/m²K

U_f -value: 1,542 W/m²K

Materials:

Material	R (m²K/W)	T (°C)	Q(gesamt) (W/m)	10077 konform
****ADIABAT****	0,000	0,000	0,000	
1 boundary condition outside 0,04, 0°C, 80%	0,040	0,000	-9,297	X
1 boundary condition inside 0,13, 20°C, 50%	0,130	20,000	5,898	X
1 boundary condition inside 0,20, 20°C, 50%	0,200	20,000	3,399	X
1 air EN ISO 10077-2 (cavities in profiles)				X
1 air EN ISO 10077-2 (cavities in profiles <=2mm)				X
1 air EN ISO 10077-2 (cavities in profiles, sparse ventilated)				X
Material	L (W/mK)	Emiss		10077 konform
2 Hardwood - Meranti	0,160	0,900		X
2 Hardwood - Meranti 2	0,160	0,900		X
2 Hardwood - Meranti Bead	0,160	0,900		X
3 PVC-U Rigid	0,170	0,900		X
5 Q-Lon	0,060	0,900		X
6 polysulfide	0,400	0,900		X
020 Technoform Glass Insulation TGI-M 2013-10, 6,9 mm	0,310	0,900		-
6 Silicon, unfilled	0,350	0,900		X
2 Float Glass 1.0	1,000	0,837		X
SZR L=0.0219	0,022	0,900		-
2 Softwood	0,130	0,900		X