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THERMAL CALCULATION NOTE

For Villa Type 4

At

HIDD AL SAADIYAT

Saadiyat Island

Abu Dhabi – U.A.E.

Developer: Consultant:

LEAD

خطيب و علمي
شركة الإتحاد الهندسي
Khatib & Alami
Consolidated Engineering Company

Issued by : Pascal CHAUSSIN
Checked by : Pascal CHAUSSIN

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Revision N° : R00

Section 1
General Information

1.1 GENERAL

The following calculation note covers the design of the windows and doors schedule for the Villa Type 4of the following project:

"HIDD AL SAADIYAT"
Saadiyat Island
Abu Dhabi - UAE

This document is carried out according to architectural drawings, specifications related to the project, relevant standards and shop drawings HIDD-AJB-AJAL-T04-SD-A-506-508/ Rev 1, HIDD-AJB-AJAL-T4-SD-A-520-524 Rev 03 , HIDD-AJB-AJAL-T4-SD-A-525 Rev 04 and related aluminium sections details.

1.2 SPECIFICATIONS REQUEST

1.2.1 Section 084413 of Specifications

According to the requirements of Section 084413 of Specifications regarding "Glazed and Aluminium Curtain Wall", aluminium frames and glass shall comply will the following:

> Art 1.4: Performance requirements, part K:
> *Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 3,92 W/sq. m x K as determined according to NFRC 100.*
>
> Art 1.6: Submittals, part B: Estidama Performances:
> *Demonstrating the Glazing System achieves energy targeted reductions in annual external heat gain attributed to passive design measures outlined in the Estidama Design Report using a dark grey colored double glazed insulated glazing system with a combined glass and thermally broken U-value of 1.5 and glass SHGC of 0.2*

1.2.2 Section 0851113 of Specifications

According to the requirements of Section 085113 of Specifications regarding "aluminium windows", aluminium frames and glass shall comply will the following:

> Art 1.6: Submittals, part B: Estidama Performances:
> *Demonstrating the Glazing System achieves energy targeted reductions in annual external heat gain attributed to passive design measures outlined in the Estidama Design Report using a dark grey colored double glazed insulated glazing system with a combined glass and thermally broken U-value of 1.5 and glass SHGC of 0.2*
>
> Art 2.2: Window, part D.1: Thermal Transmittance:
> *U-factor: 1,5 W/sq. m x K or less*

1.2.3 Section 088000 of Specifications

According to the requirements of Section 0880000 of Specifications regarding “Glazing”, insulated glass shall comply will the following:

Art 2.10: Insulating glass type Part A: Aluminium window glass type
7. Sumer daytime U-factor: 1.8 maximum

1.3 MUTUAL AGREEMENT

According to specification, respectively section 084413 for curtain walls and 0851113 for windows, the U-value requested shall be less than 1.5 W/ sq. m x K.

However, subsequent to MAT-ARCH 0129 Rev 2 a meeting was hold by parties on 27/05/2014 to clarify conflict between U-value requested by specifications and by Estidama Pearl 2.

All parties agreed for a Whole window U-value of 1.7 W/ sq. m x K or less for the project.

Accordingly, calculation notes of all villas will be achieved to demonstrate the compliance with this request.

Section 2
Design and Windows Schedule

2.1 WINDOWS SCHEDULE

Appendix A represents elevations of windows of the Villa Type 4 .
These windows could be split according to the following type:

- Sliding windows 2 shutters
- Sliding doors 2,3 or 4 shutters
- Hinge Door
- Top Hung Window
- Top Hung Window with Fixed
- Curtain wall

The above mentioned spreadsheet represents the location and surface of these various type of windows

A - SLIDING DOOR - 2SHUTTER						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-17	BED ROOM-1	1730	2990	5.1727	1	5.1727
TOTAL					1	5.1727

B - SLIDING DOORS- 3SHUTTER						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-16	BED ROOM-02	2690	2990	8.0431	1	8.0431
CW-20	FAMILY DINING	2690	2990	8.0431	1	8.0431
TOTAL					2	16.0862

C - SLIDING DOORS - 4 SHUTTER						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-14	MASTER BED	3190	2990	9.5381	1	9.5381
CW-24	BED ROOM-04	3590	2990	10.7341	1	10.7341
CW-03	GUEST BEDROOM, MAJILIS	3590	3290	11.8111	2	23.6222
TOTAL					4	20.2722

D- SLIDING DOORS - 5 SHUTTER						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-13	BED ROOM-01	4490	2990	13.4251	1	13.4251
CW-15	BED ROOM-03	4070	2990	12.1693	1	12.1693
TOTAL					2	25.5944

E- HINGE WINDOWS						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
GW-03	FORMAL WC -GF	1590	590	0.9381	1	0.9381
TOTAL					1	0.9381

F- CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-23	NEAR STAIR - 01	1780	3900	6.942	1	6.942
CW-01	STAIR CASE	2550	6880	17.544	1	17.544
CW-22	FAMILY LIVING	4420	7180	31.7356	1	31.7356
CW-04	MAJILIS	5385	3280	17.6628	1	17.6628
CW-11	FAMILY LOBBY	1480	2980	4.4104	1	4.4104
TOTAL					5	78.2948

G- TOP HUNG WINDOW WITH FIXED						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
GW-01	BATH 4,BATH 1-FF	590	1790	1.0561	2	2.1122
GW-04	DRIVERS BATH	590	2390	1.4101	1	1.4101
GW-04A	DRIVERS ROOM	590	2390	1.4101	1	1.4101
GW-04B	MAIDS ROOM	590	2390	1.4101	1	1.4101
GW-04C	FAMILY W.C,GUEST BATH	590	2390	1.4101	2	2.8202
GW-05	MASTERS BATH	1590	1790	2.8461	1	2.8461
TOTAL					8	12.0088

H- KITCHEN -GF						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
GW-02	KITCHEN -GF	3490	540	1.8846	1	1.8846
TOTAL					1	1.8846

I- FIXED FRAME						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
GW-10	FAMILY LIVING	590	2990	1.7641	3	5.2923
TOTAL					3	5.2923

J - COMBINED CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-06	FORMAL LIVING	7125	3280	23.37	1	23.37
TOTAL					1	23.37

K - CURTAIN WALL WITH DOOR						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-21	FAMILY LIVING	2680	7180	19.2424	1	19.2424
TOTAL					1	19.2424

L - SKY LIGHT						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
GW-08	ROOF	6280	1200	7.536	1	7.536
GW - 07	ROOF	2880	1340	3.8592	1	3.8592
GW-11	ROOF	7120	1180	8.4016	1	8.4016
GW -06	ROOF	1780	880	1.5664	2	3.1328
TOTAL					5	22.9296

2.2 DESIGN

Design of windows above mentioned has been defined through aluminium sections details HIDD/AJB/AJAL-T4-SD-A-575 to 598

Accordingly, Thermal calculation notes will be achieved on the above mentioned shop drawings.

Section 3
Calculation Notes Data

3.1 THERMAL TRANSMITTANCE OF THE FRAME SECTION

The thermal transmittance of the frame section is defined with reference to Annex C of ISO 10077-2:2012 as following:

- In the calculation model the glazing (or opaque panel) is replace by an insulation panel with thermal conductivity λ=0,035 W/m.K inserted into the frame.
- According to ISO 10077-2:2012, calculation does not include effect of solar radiation, heat transfer caused by air leakage or three dimensional heat transfer such as pin point metallic connections.
- According to ISO 10077-2:2012, thermal bridge effect between the frame and building structure are not included.
- The calculation is carried out using a two dimensional numerical method conforming to ISO 10211.
- The calculated two-dimensional thermal conductance $L^{2D}{}_f = \Phi/(T_2-T_1)$ is issued from Flixo software calculation regarding the value of the heat transfer Φ(in W/m) of the section.
- For frame with special extensions overlapping the wall or other building elements, the extension shall be disregarded as per art 5.5 of ISO 10077-2:2012.

According to previous information above mentioned, the value of the thermal transmittance of the frame, U_f, is defined by:

$$U_f = \frac{L^{2Df} - Up.bp}{b_f} = \frac{\Phi/(T_2 - T_1) - Up.bp}{b_f}$$

Where:

U_f is the thermal transmittance of the frame section expressed in W/m²K.
T_2 is the temperature on one side expressed in K.
T_1 is the temperature in the other side expressed in K.
U_p is the thermal transmittance of the central area of the panel expressed in W/m²K.
b_f is the projected width of the frame section expressed in m.
b_p is the visible width of the panel expressed in m.

Thermal conductivities of materials are defined in compliance with Annex A.1 of ISO 10077-2:2012.

3.2 THERMAL TRANSMITTANCE OF A SINGLE WINDOW

According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

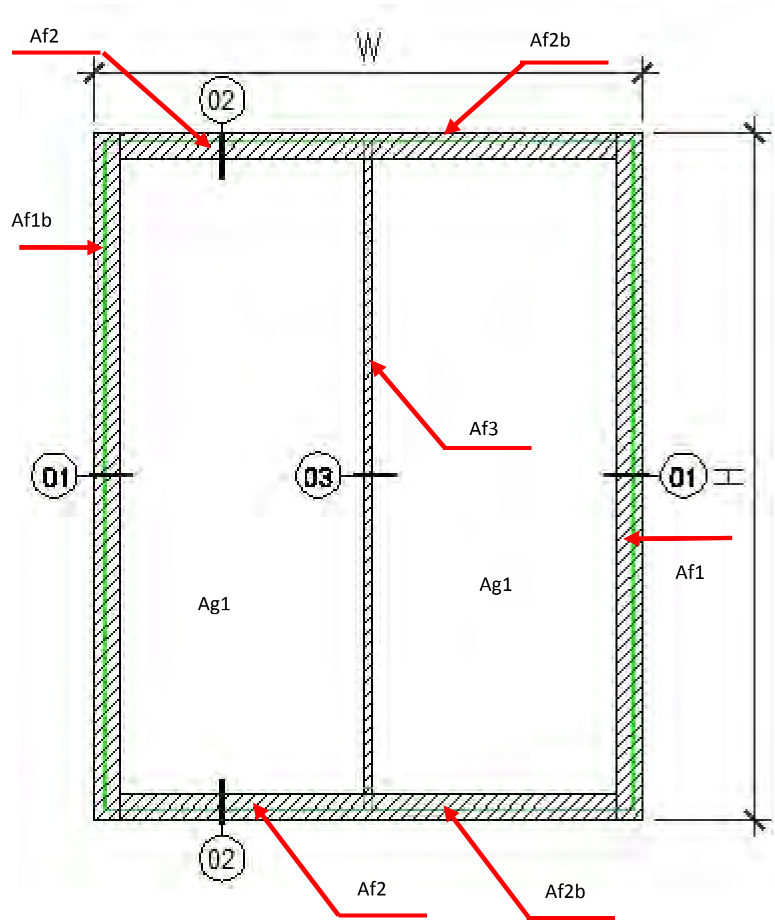
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Where:

U_g is the thermal transmittance of the glazing
A_g is the glazing projected area
U_f is the thermal transmittance of the frame
A_f is the larger of the two projected frame area (inside & outside projected)
Ψg is the linear thermal transmittance due to the combined thermal effects of glazing, spacer and frame.
l_g is the sum of the visible perimeter of the glass panes.
A_w, the window area, is the sum of the frame area A_f, and the glazing area A_g.

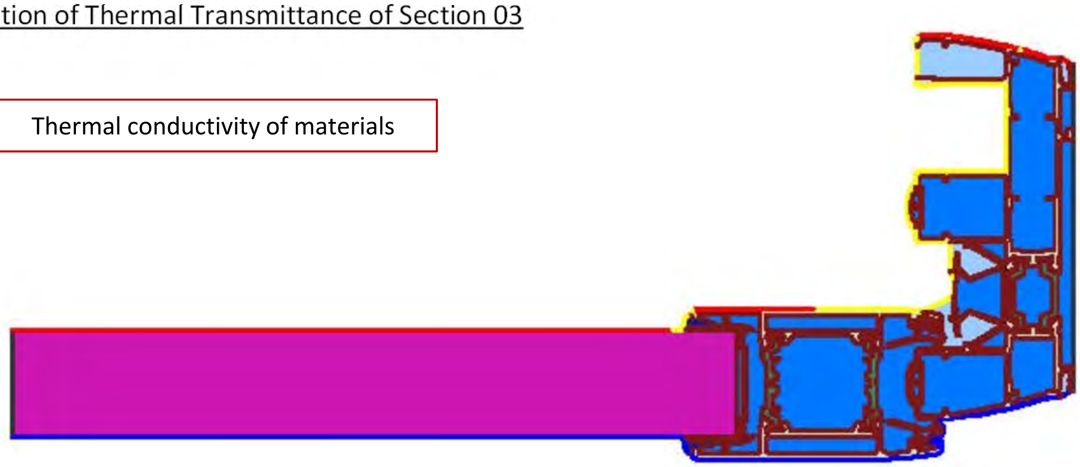
Section 4
Single window thermal transmittance

4.1 SLIDING DOOR – 2 SHUTTERS:



4.1.1 Calculation of Thermal Transmittance of Section 03

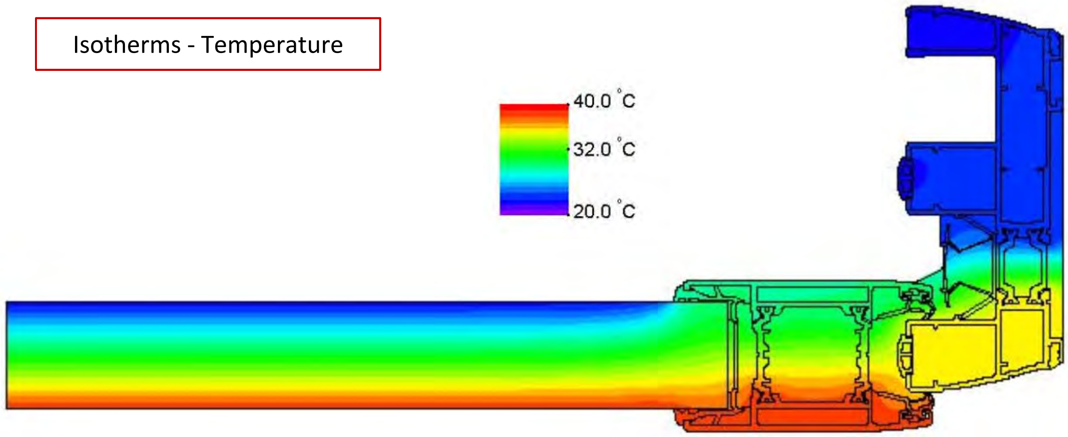
Thermal conductivity of materials



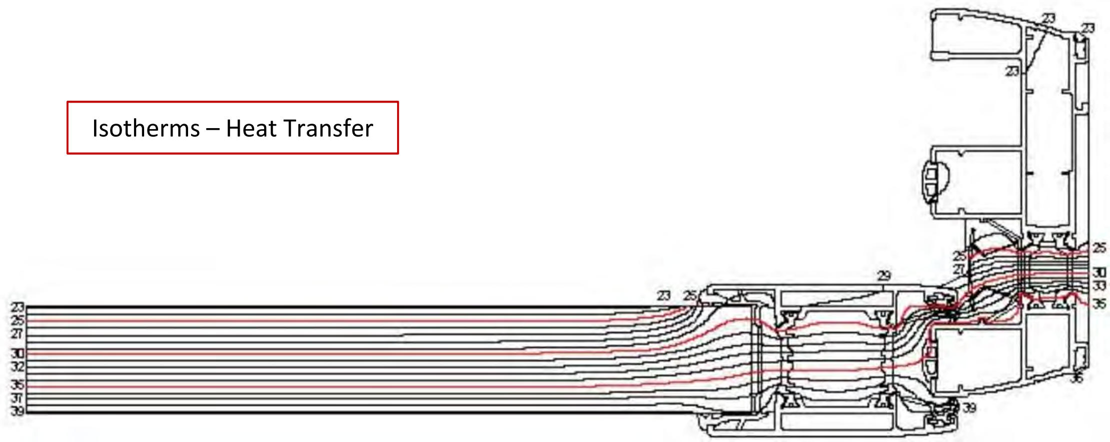
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

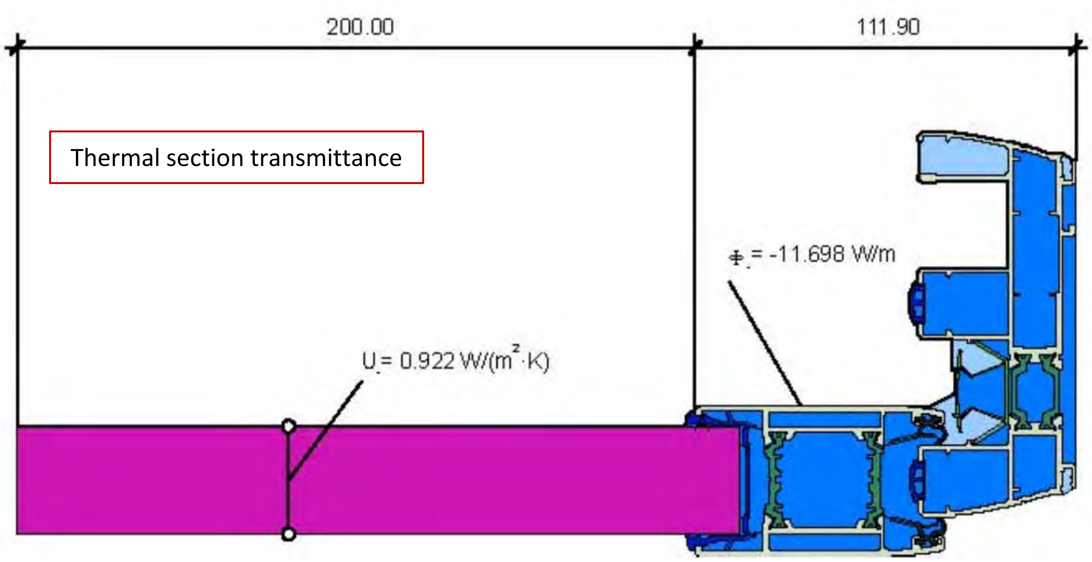
Isotherms - Temperature



Isotherms – Heat Transfer



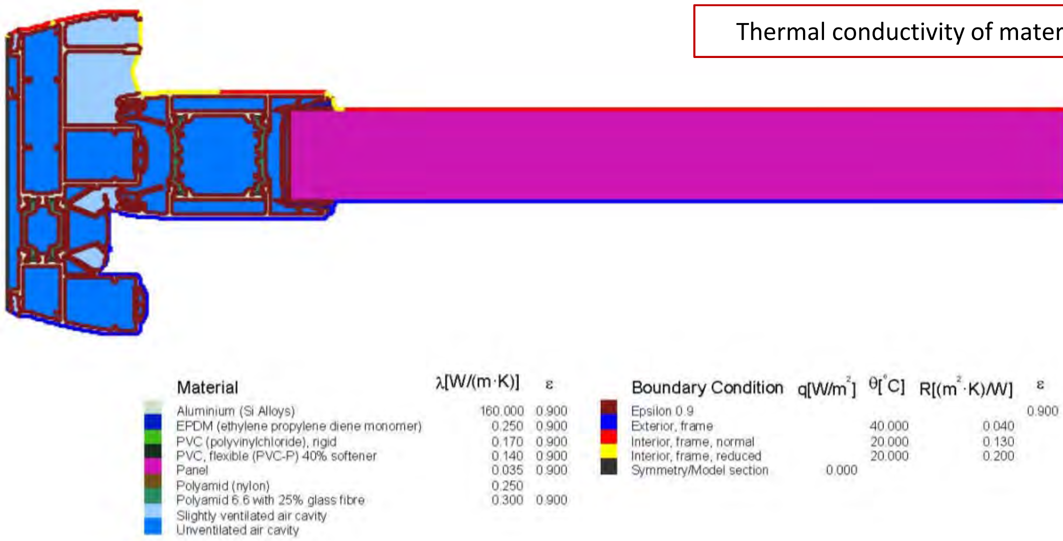
Thermal section transmittance



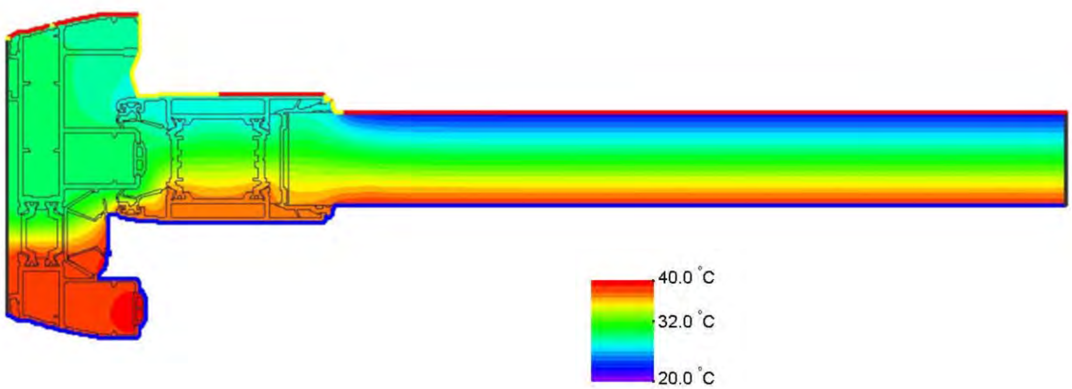
$$U_{TA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_T} = \frac{\frac{11.698}{20.000} - 0.922 \cdot 0.200}{0.112} = \boxed{3.58\ W/(m^2 \cdot K)}$$

4.1.2 Calculation of Thermal Transmittance of Section 03b

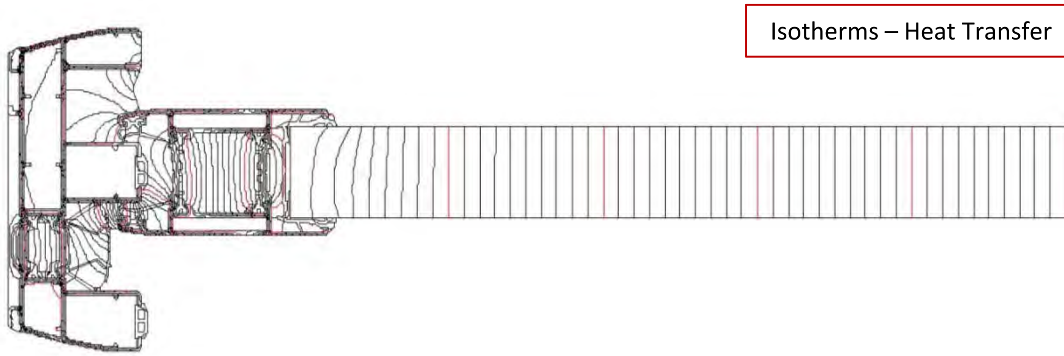
Thermal conductivity of materials



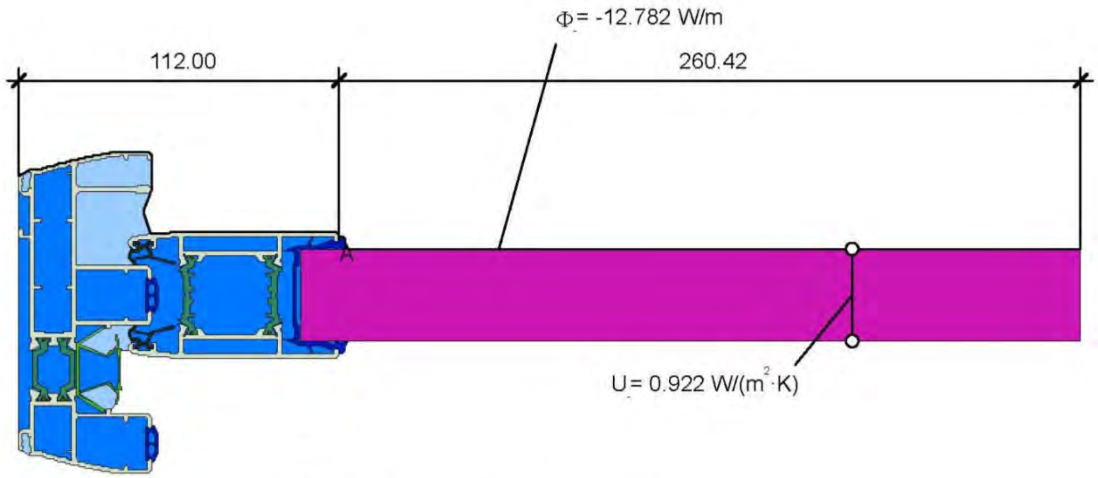
Isotherms - Temperature



Isotherms – Heat Transfer

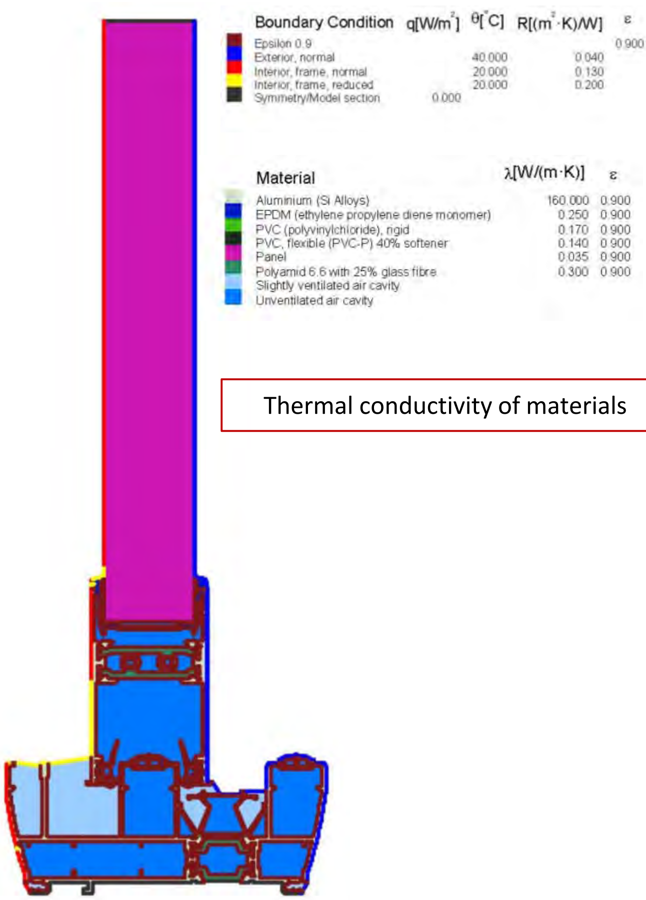


Thermal section transmittance

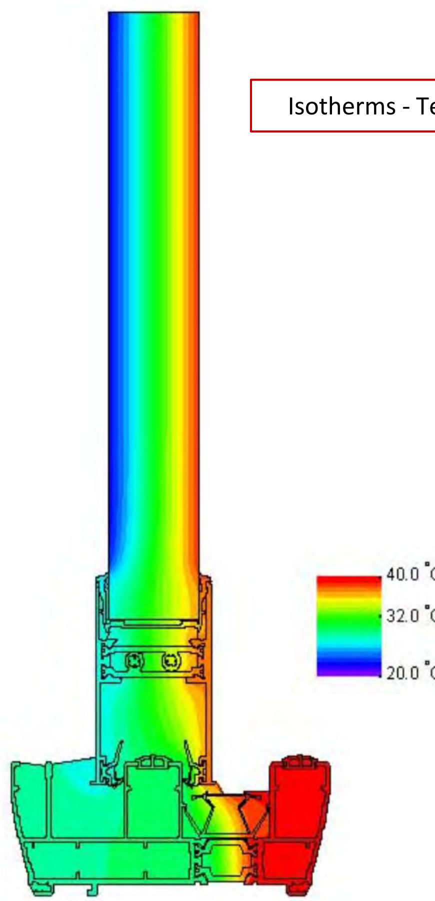


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{12.782}{20.000} - 0.922 \cdot 0.260}{0.112} = \boxed{3.56\ W/(m^2 \cdot K)}$$

4.1.3 Calculation of Thermal Transmittance of Section 04

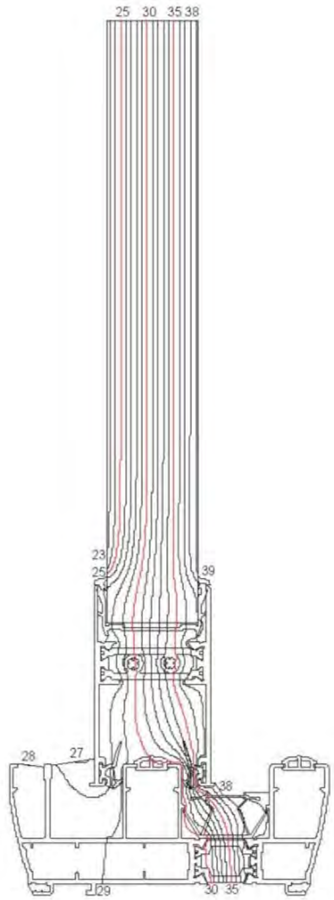


Thermal conductivity of materials

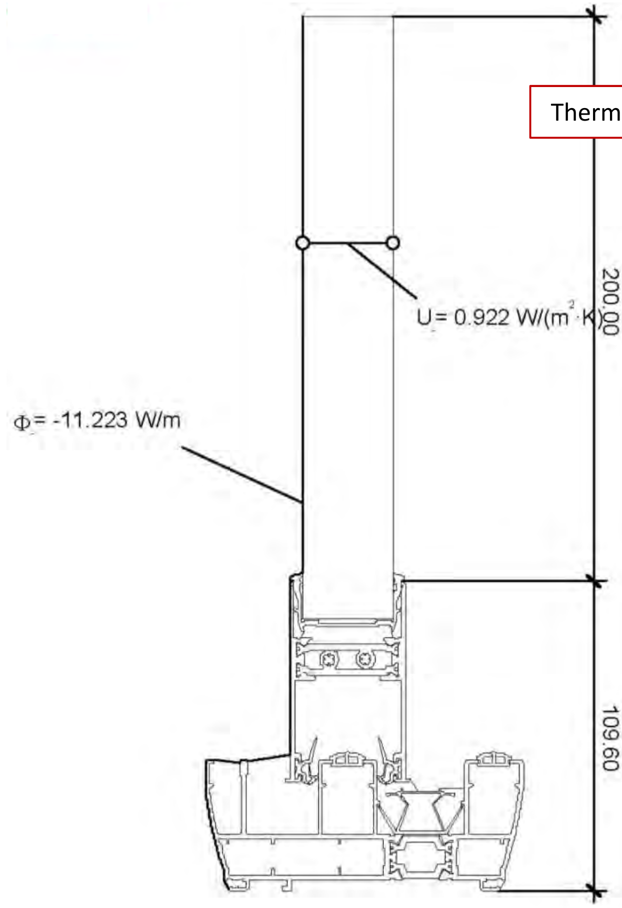


Isotherms - Temperature

Isotherms – Heat Transfer

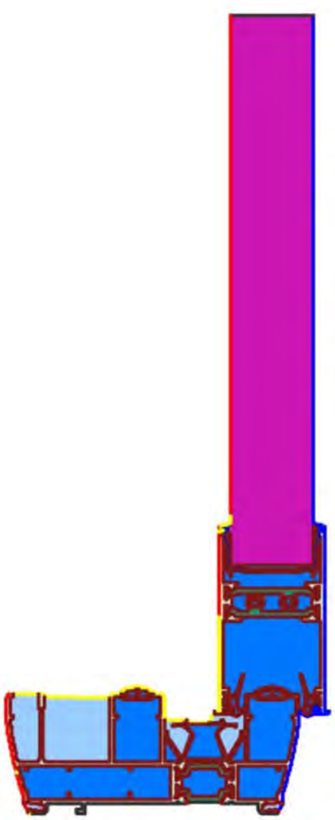


Thermal section transmittance



$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$

4.1.4 Calculation of Thermal Transmittance of Section 04b

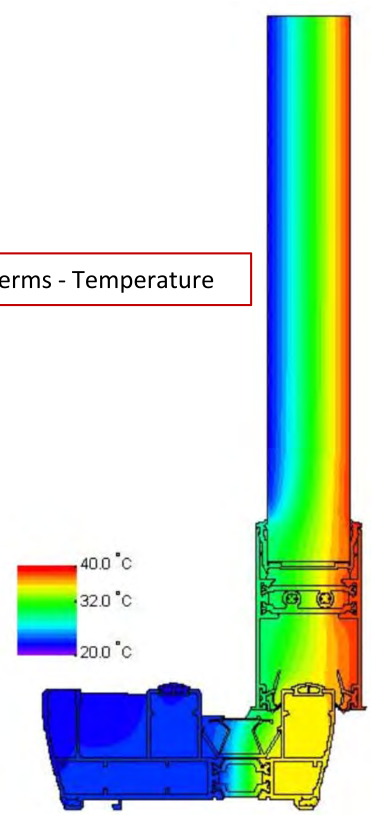


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

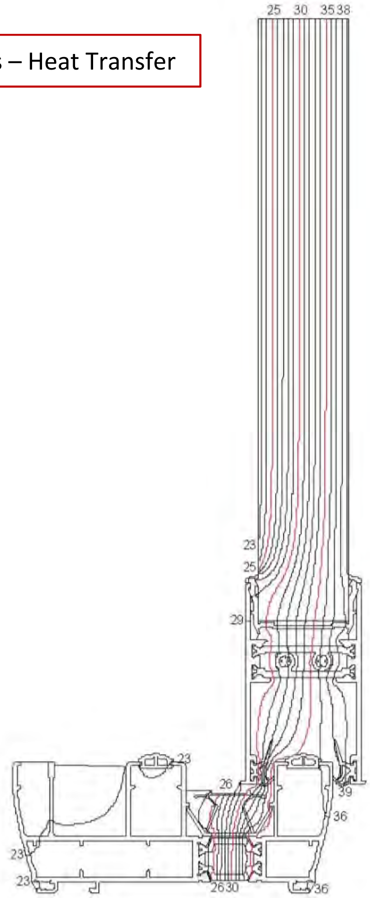
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Thermal conductivity of materials

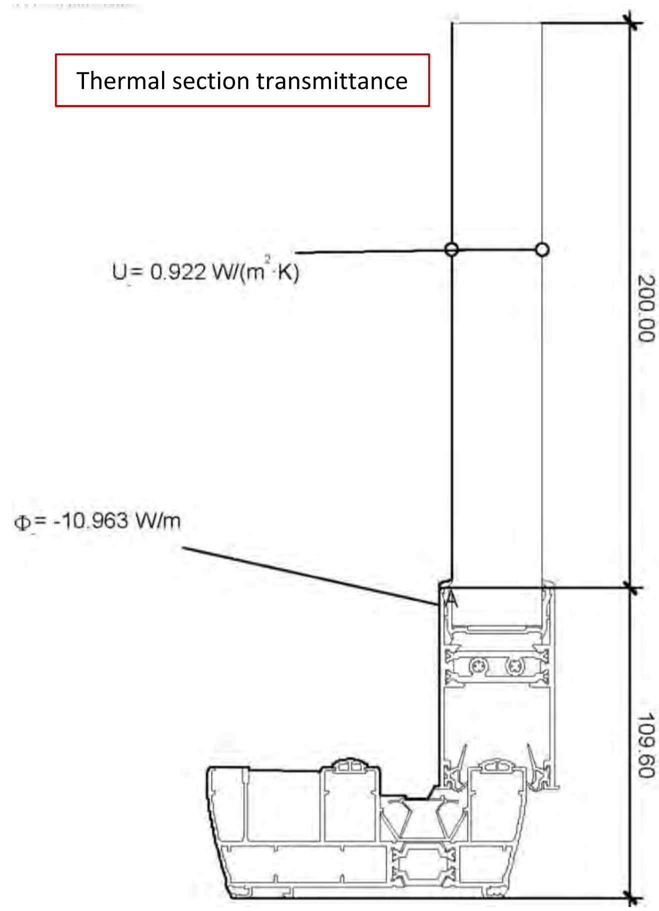
Isotherms - Temperature



Isotherms – Heat Transfer

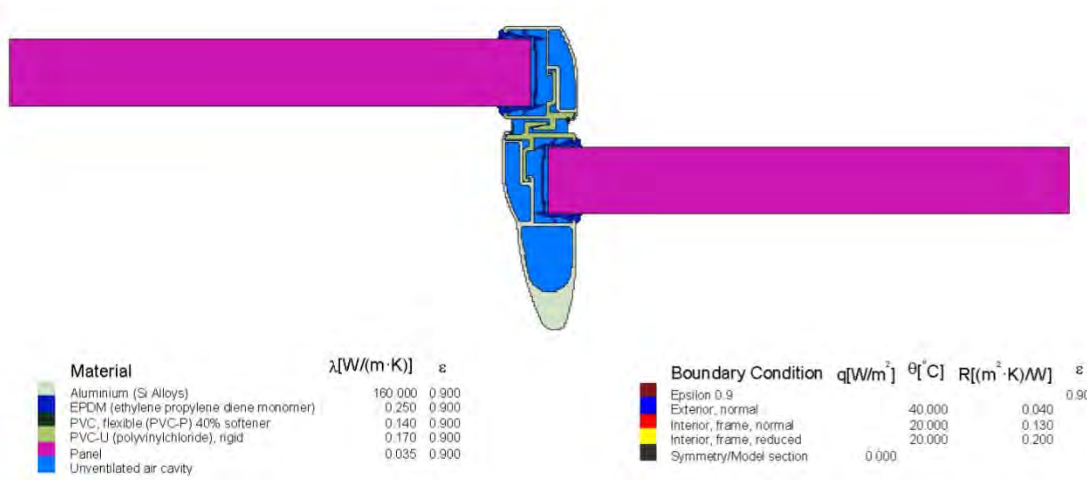


Thermal section transmittance



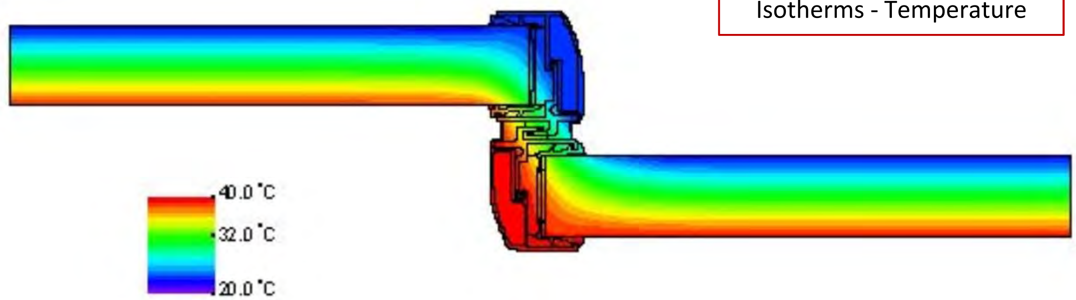
$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{10.963}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.32\ W/(m^2 \cdot K)}$$

4.1.5 Calculation of Thermal Transmittance of Section 05

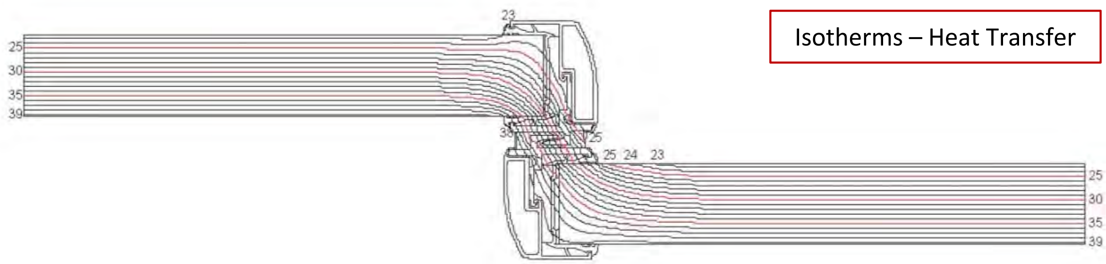


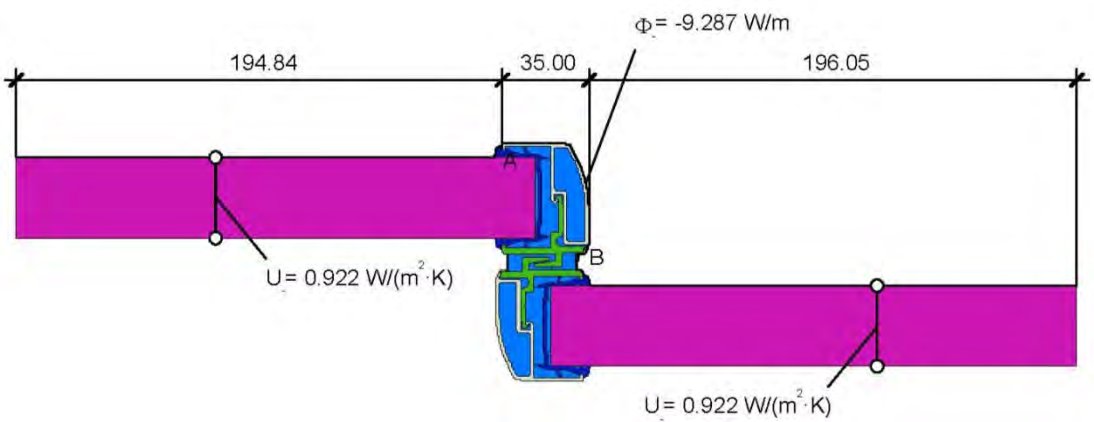
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer





Thermal section transmittance

$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97\ \mathrm{W/(m^2 \cdot K)}$$

Thermal transmittance of Sliding Door – 2 Shutters

A SLIDING DOOR - 2SHUTTERS				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-17	BED ROOM 1	1730	2990	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

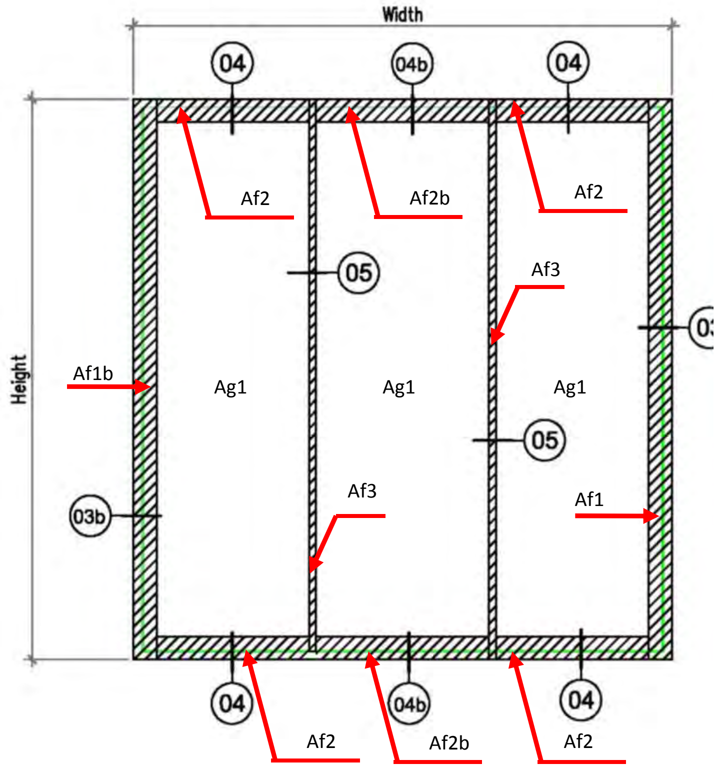
S

Result :

Dimension	Width	in[m]	1.730		Total window Area	in [m²]	5.173
	Height	in[m]	2.990				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.110	Glass area Ag1	Surface / unit	in [m²]	2.043
	Total Frame Area	in [m²]	0.329		Quantity		2.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	4.086
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.329		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.560		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.012
	Total Frame Area	in [m²]	0.162		Quantity		2.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	14.024
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.162		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.320		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.105				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	S 1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	1.087	Total Glass Area		in [m²]	4.086
S Af*Uf =	3.445	in [W/m²K]					
S Ag*Ug =	4.904	in [W/m²K]					
S Af*Uf =	0.7012	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.749**

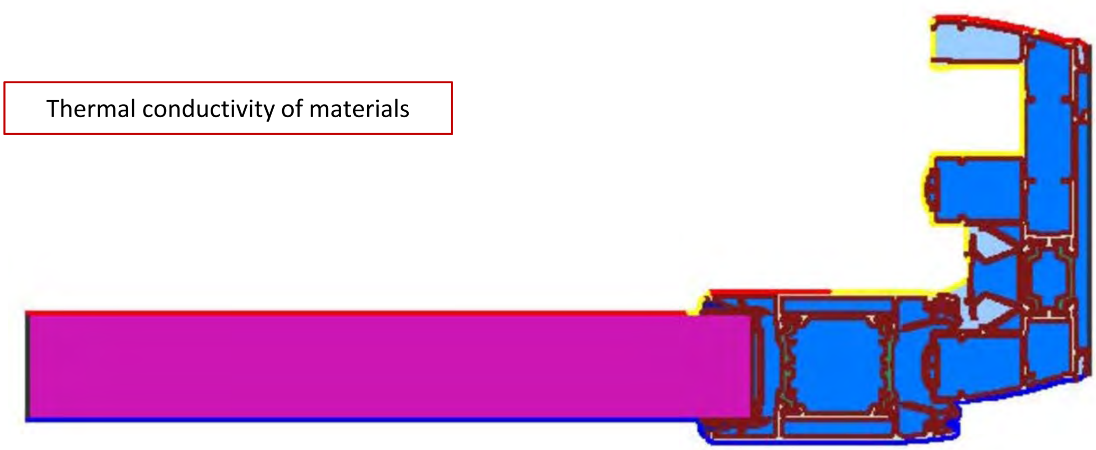
4.2 SLIDING DOOR – 3 SHUTTERS:

B- SLIDING DOORS - 3 SHUTTERS				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-02	FAMILY DINING,LIVING	3590	3290	3
CW-08	BED ROOM 3&,5, MASTERS BED ROOM	3590	3290	3
TOTAL				6



4.2.1 Calculation of Thermal Transmittance of Section 03

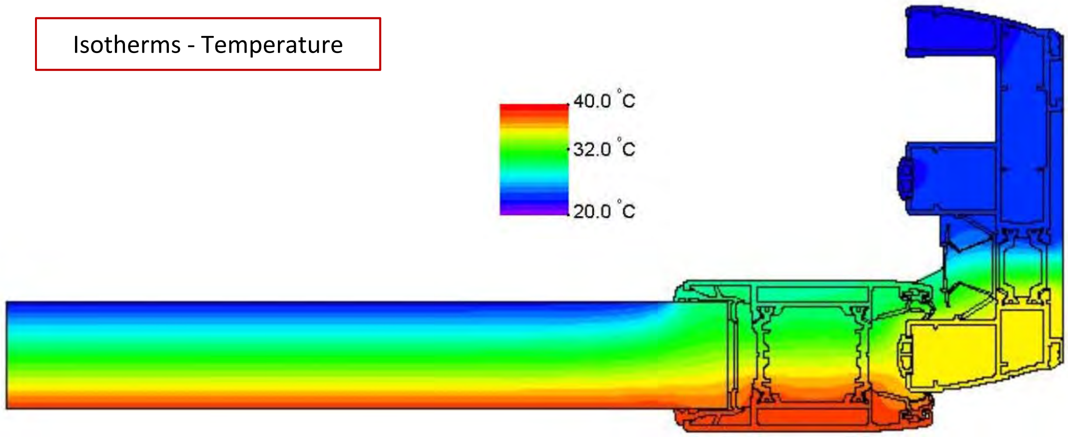
Thermal conductivity of materials



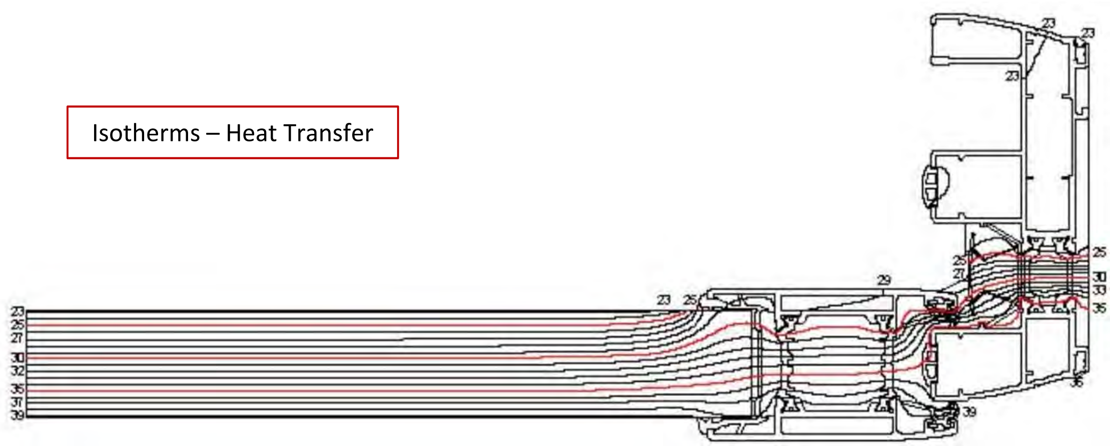
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

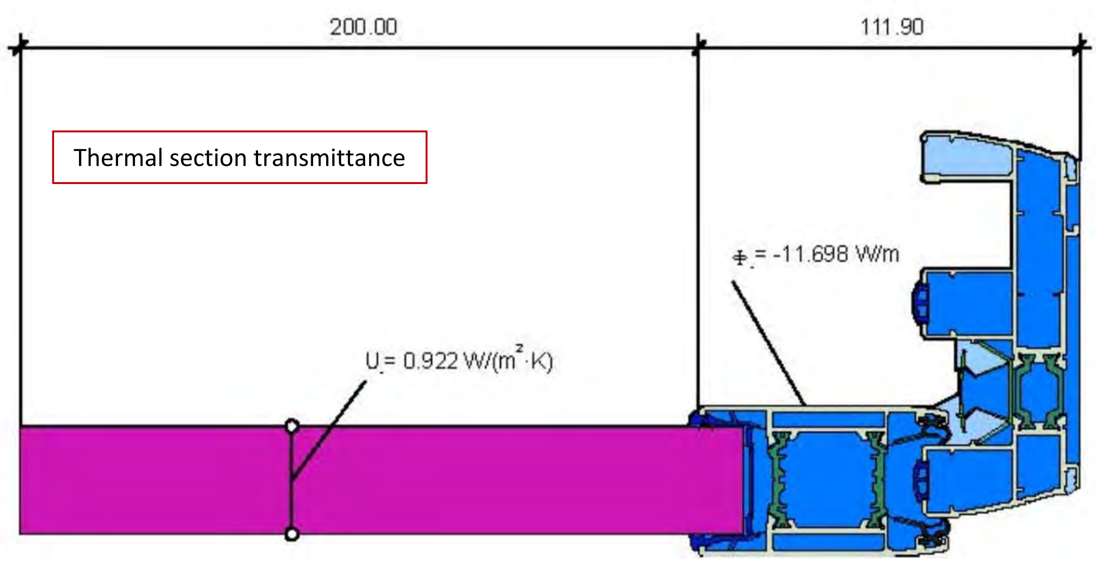
Isotherms - Temperature



Isotherms – Heat Transfer



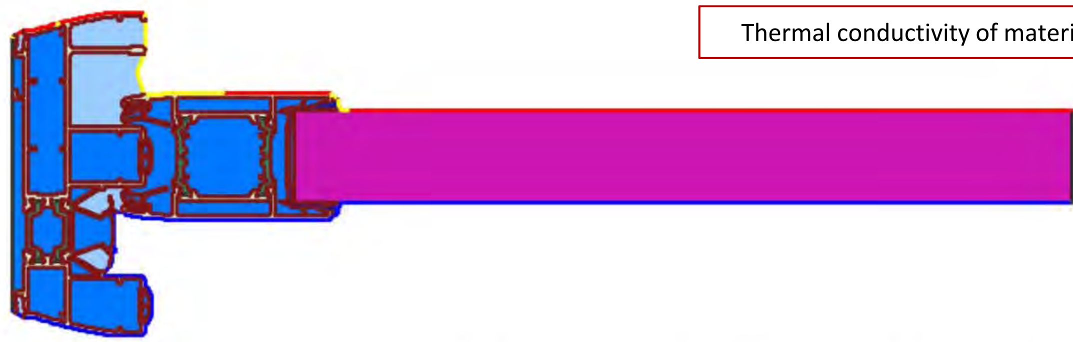
Thermal section transmittance



$$U_{TA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.698}{20.000} - 0.922 \cdot 0.200}{0.112} = \boxed{3.58\ W/(m^2 \cdot K)}$$

4.2.2 Calculation of Thermal Transmittance of Section 03b

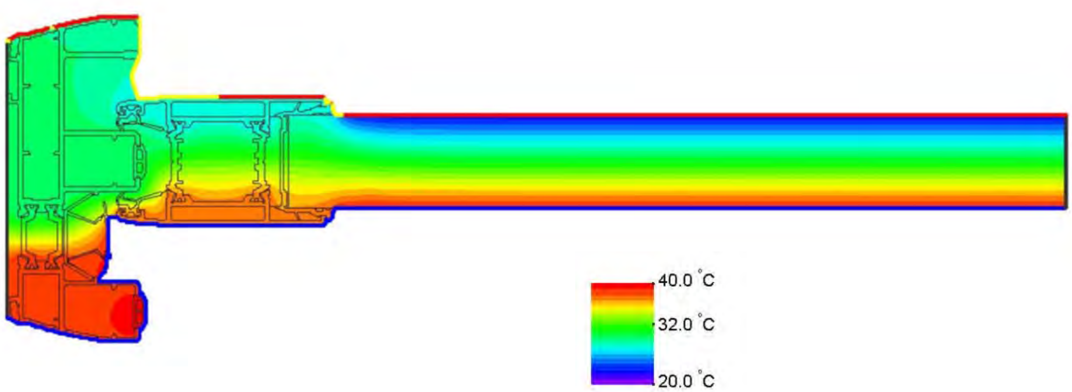
Thermal conductivity of materials



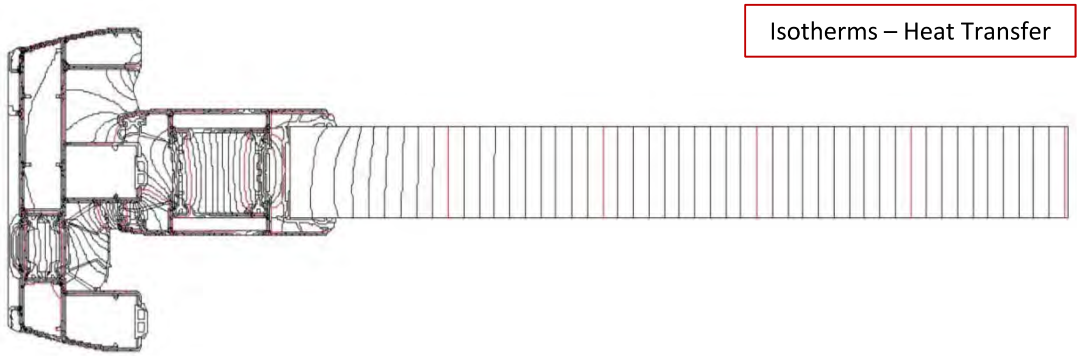
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

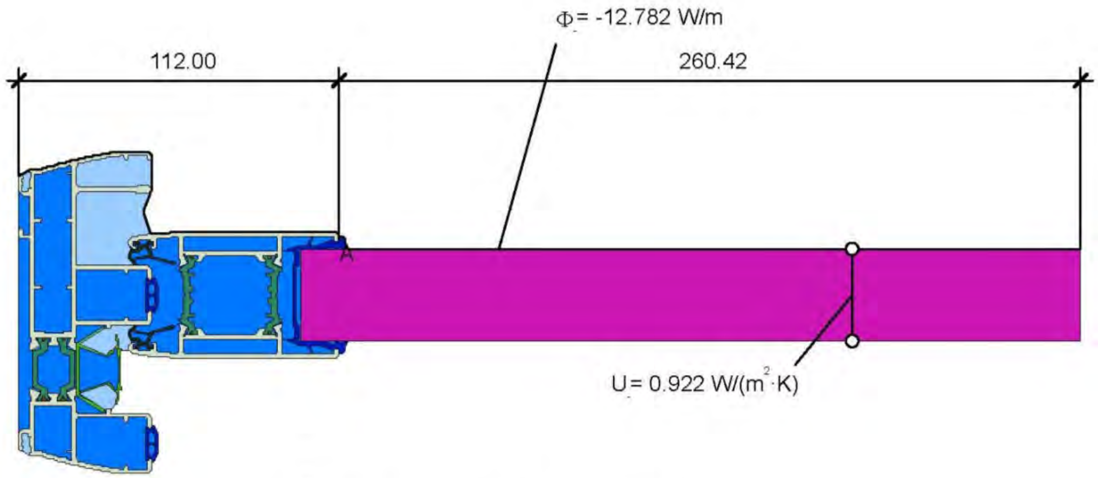
Isotherms - Temperature



Isotherms – Heat Transfer

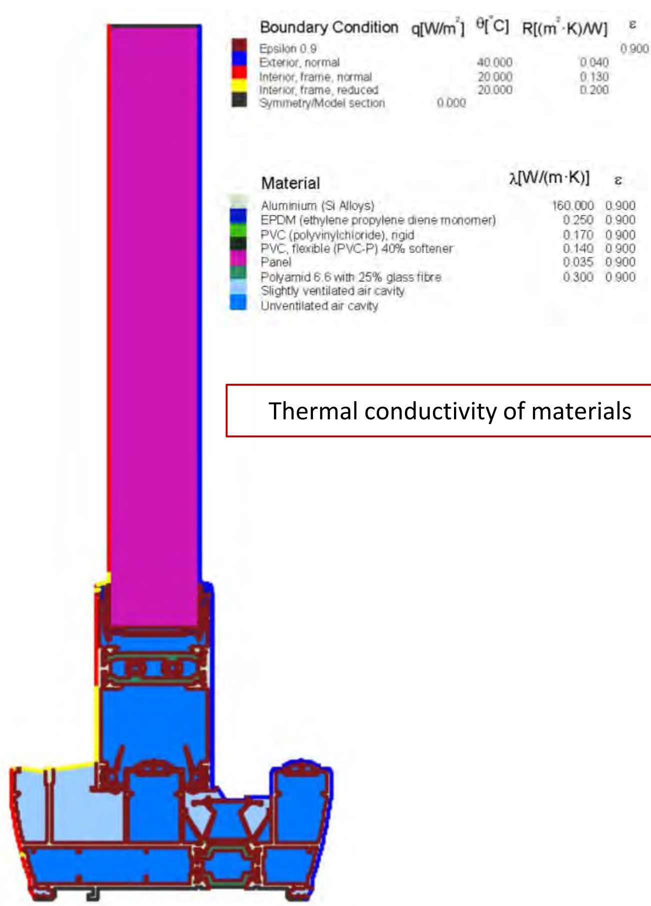


Thermal section transmittance

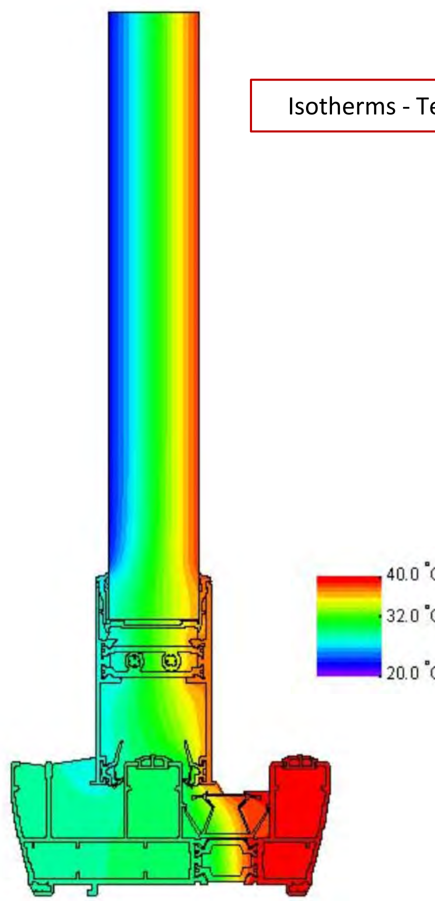


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{12.782}{20.000} - 0.922 \cdot 0.260}{0.112} = \boxed{3.56\ W/(m^2 \cdot K)}$$

4.2.3 Calculation of Thermal Transmittance of Section 04

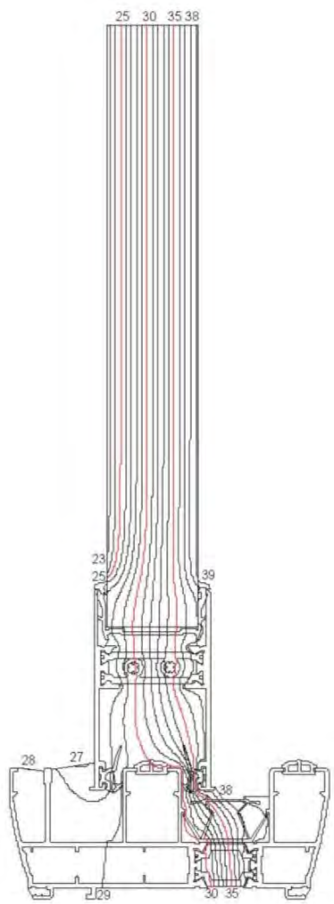


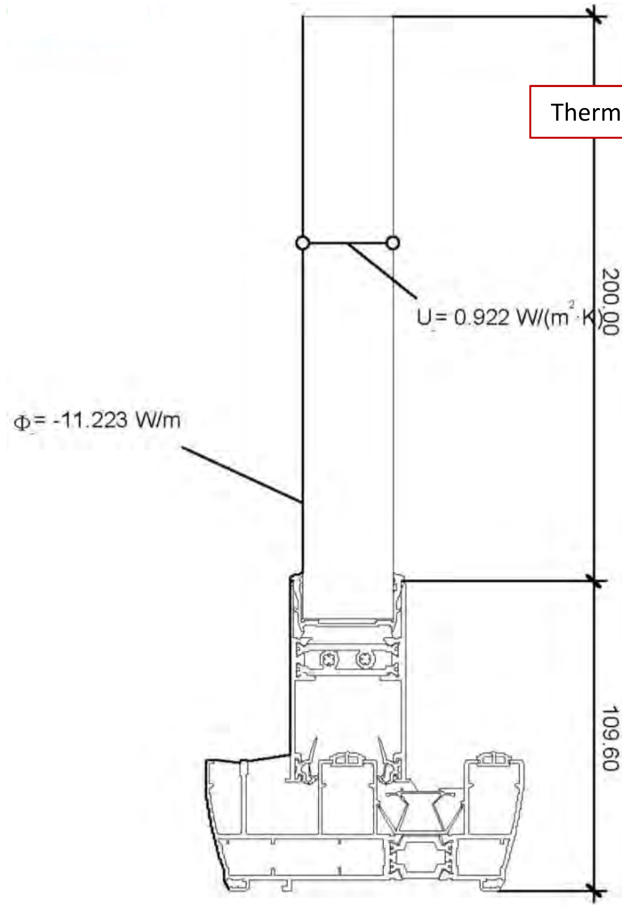
Thermal conductivity of materials



Isotherms - Temperature

Isotherms – Heat Transfer

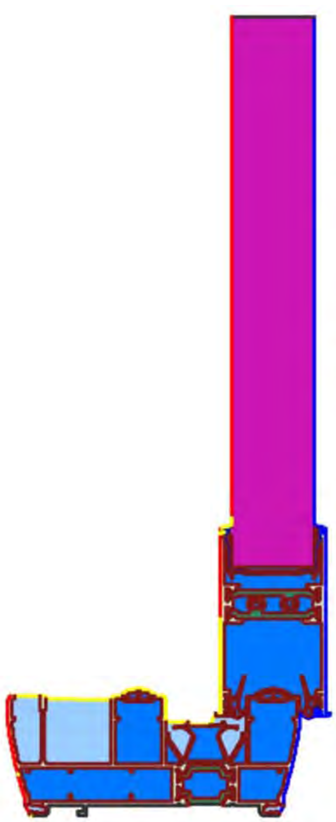




Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$

4.2.4 Calculation of Thermal Transmittance of Section 04b

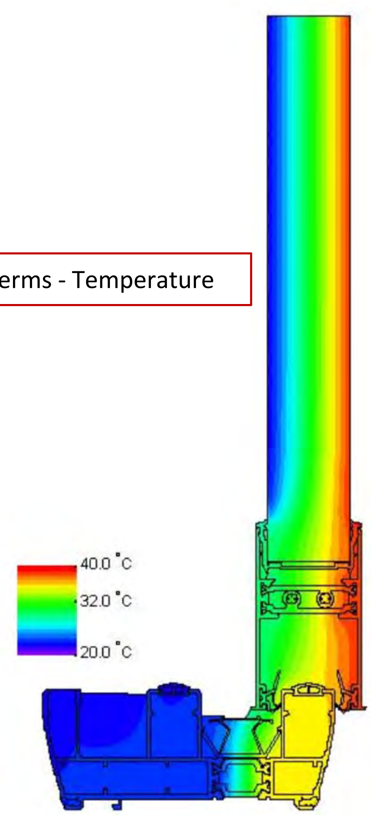


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

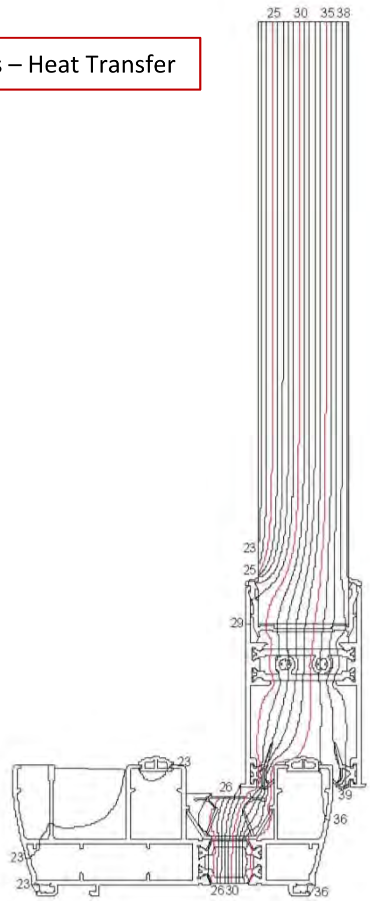
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Thermal conductivity of materials

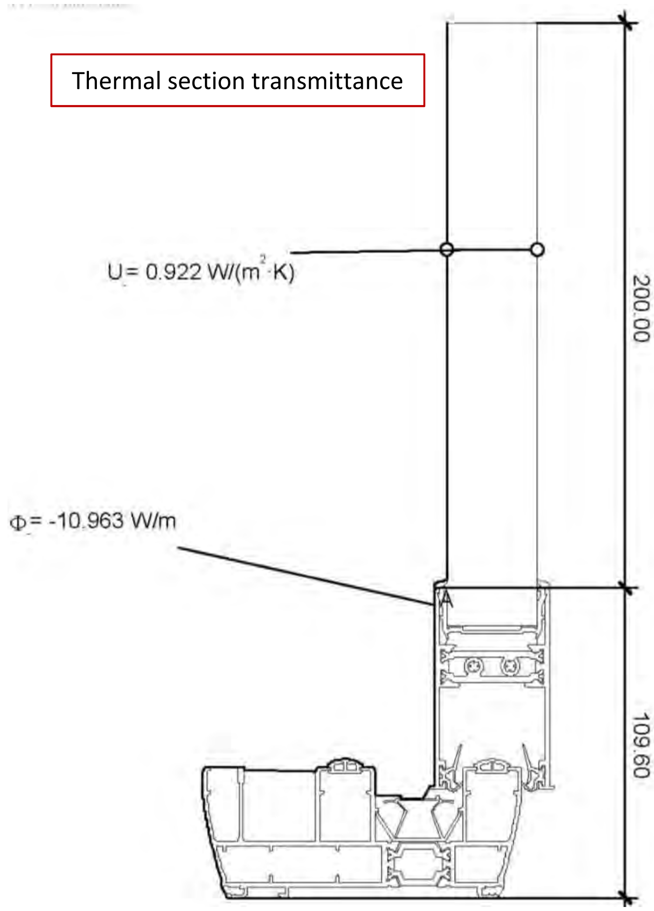
Isotherms - Temperature



Isotherms – Heat Transfer

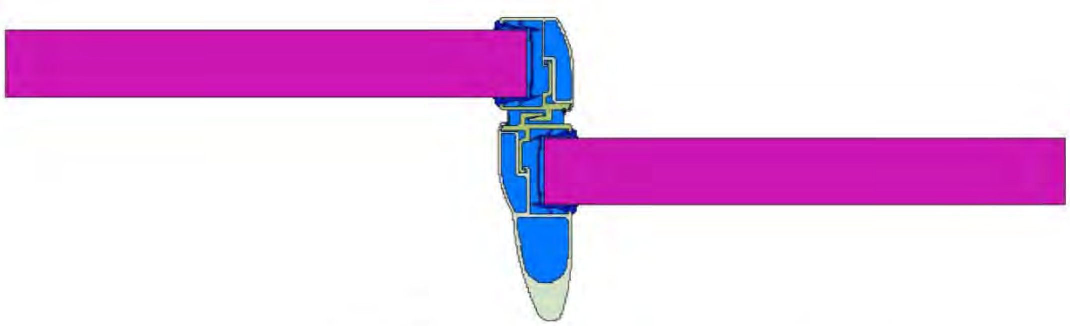


Thermal section transmittance



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{10.963}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.32\ W/(m^2 \cdot K)}$$

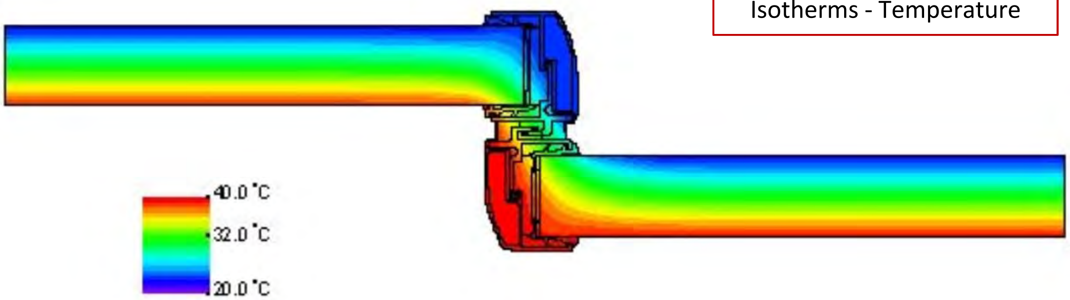
4.2.5 Calculation of Thermal Transmittance of Section 05



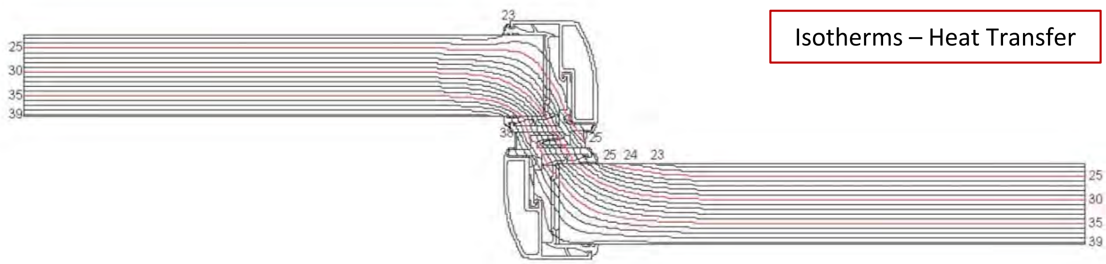
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
PVC-U (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.90
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

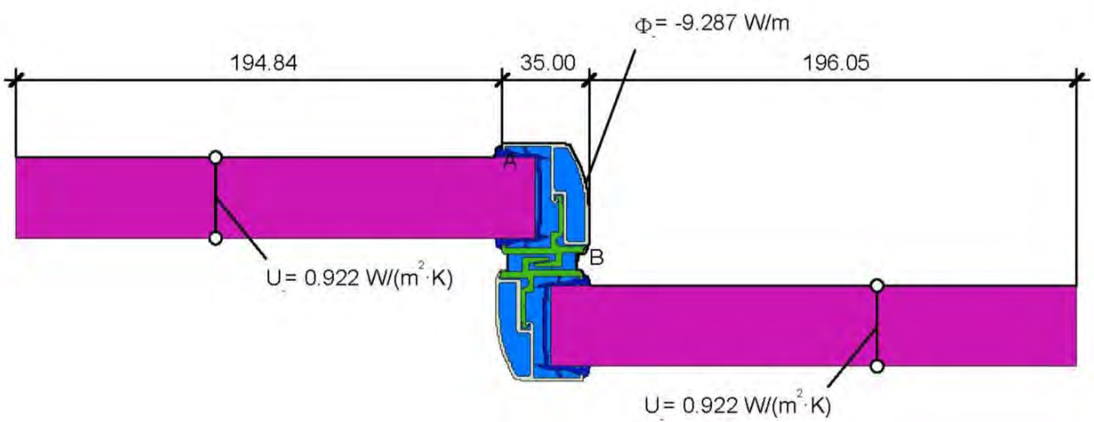
Thermal conductivity of materials



Isotherms - Temperature



Isotherms – Heat Transfer



Thermal section transmittance

$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97 \text{ W/(m}^2 \cdot \text{K)}$$

Thermal transmittance of Sliding Door – 3 Shutters

B - SLIDING DOORS - 3 SHUTTERS				
REF.	**LOCATION**	**WIDTH (in mm)**	**HEIGHT (in mm)**	**QTY**
CW-16	BED ROOM 2	2690	2990	1
CW-20	FAMILY DINING	2690	2990	1
TOTAL				2

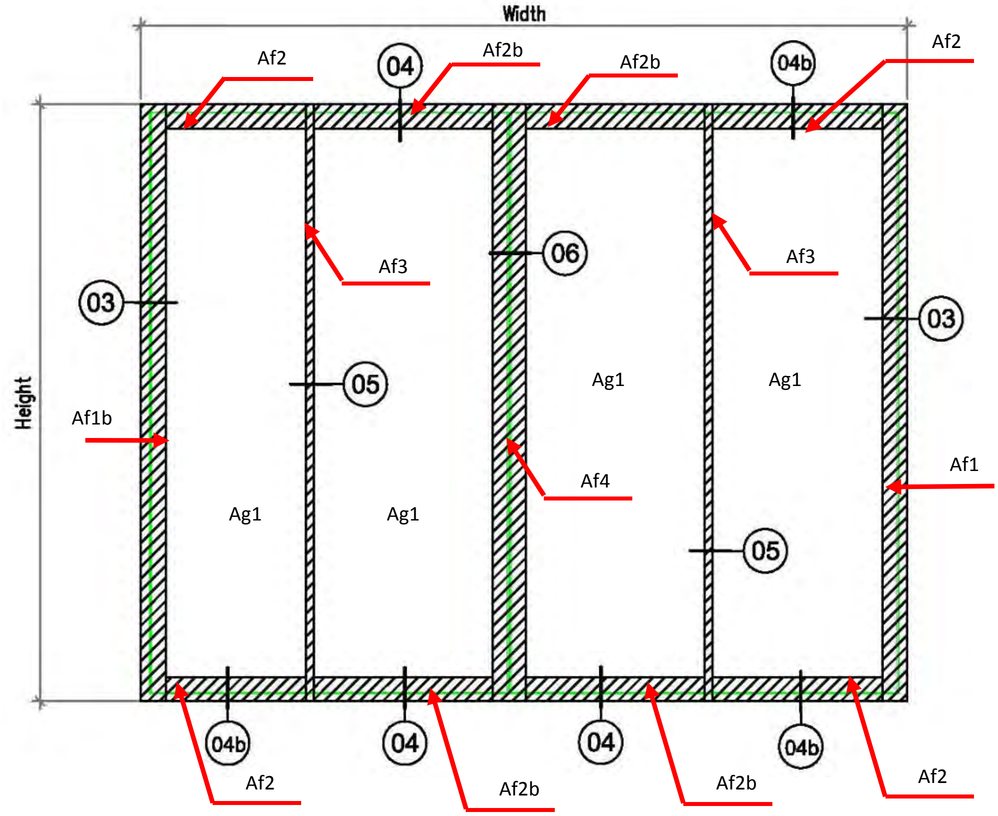
According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	2.690		Total window Area	in [m²]	7.236
	Height	in[m]	2.690				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.110	Glass area Ag1	Surface / unit	in [m²]	1.974
	Total Frame Area	in [m²]	0.296		Quantity		3.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	6.286
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.296		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.560		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	6.447
	Total Frame Area	in [m²]	0.176		Quantity		3.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	19.340
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.088		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.320		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.094				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.950	Total Glass Area		in [m²]	6.286
S Af*Uf =	3.010	in [W/m²K]					
S Ag*Ug =	7.543	in [W/m²K]					
S Af*Uf =	0.967	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.592**

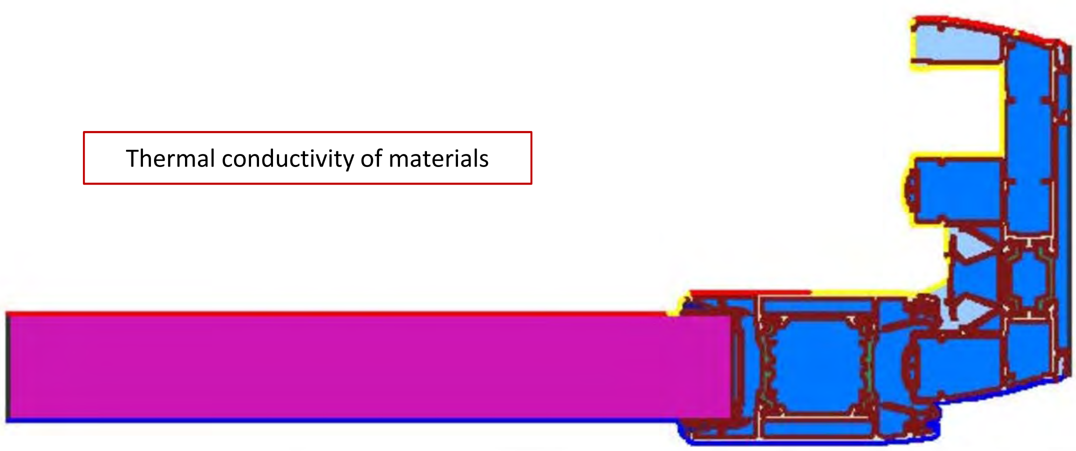
4.3 SLIDING DOOR – 4 SHUTTERS:



C- SLIDING DOORS - 4 SHUTTER				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-01	MAJLIS-GF	4790	3290	1
CW-07	BALCONY	4790	2990	1
TOTAL				2

4.3.1 Calculation of Thermal Transmittance of Section 03

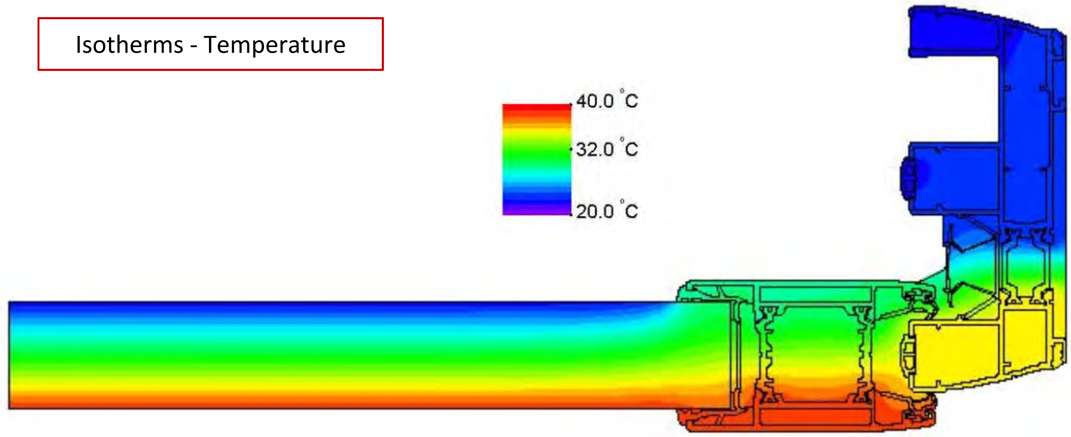
Thermal conductivity of materials



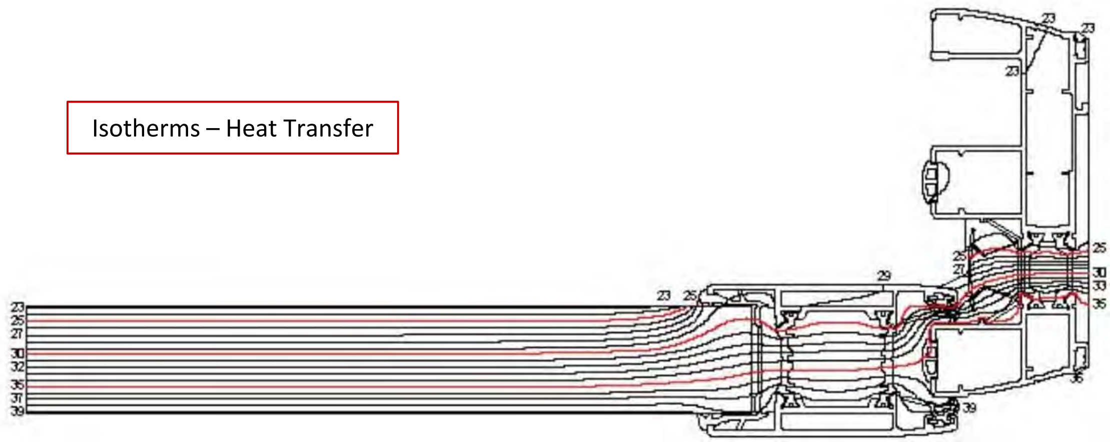
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

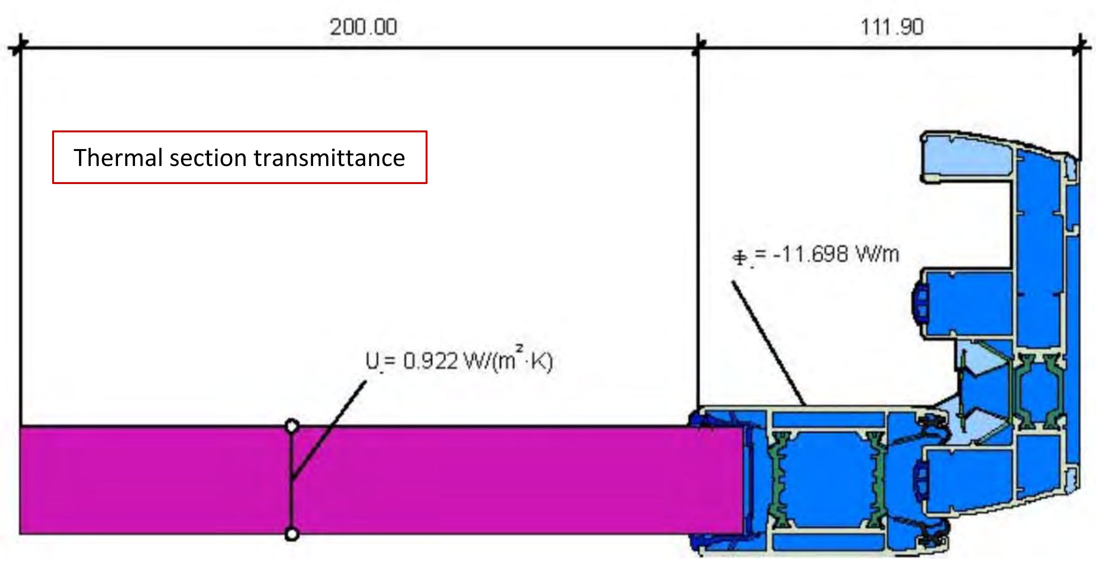
Isotherms - Temperature



Isotherms – Heat Transfer

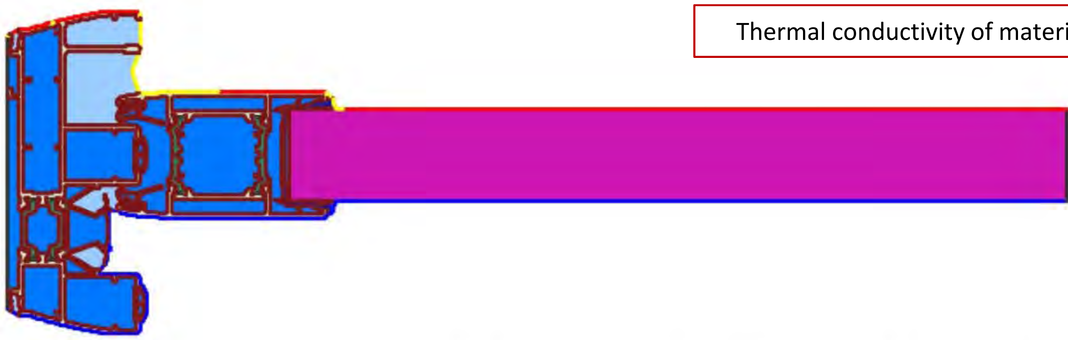


Thermal section transmittance



$$U_{TA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.698}{20.000} - 0.922 \cdot 0.200}{0.112} = \boxed{3.58\ W/(m^2 \cdot K)}$$

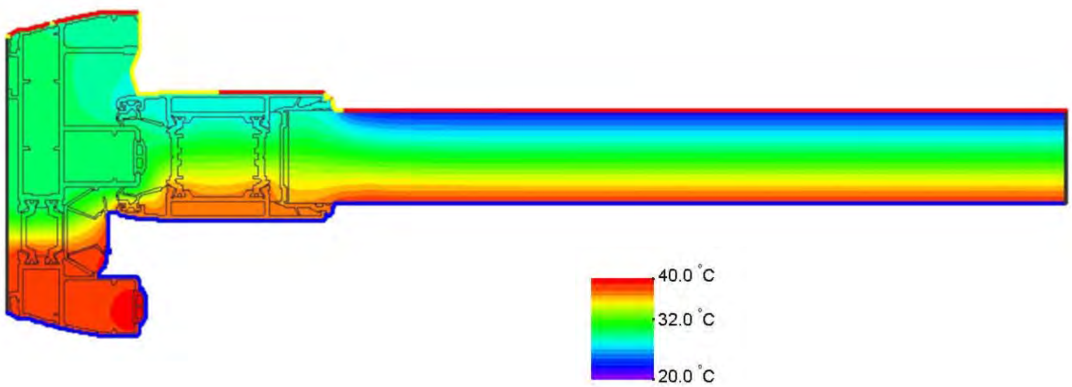
Thermal conductivity of materials



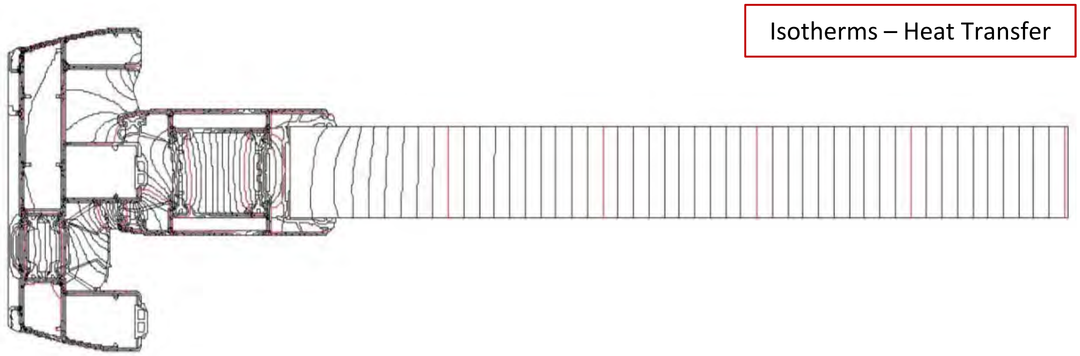
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

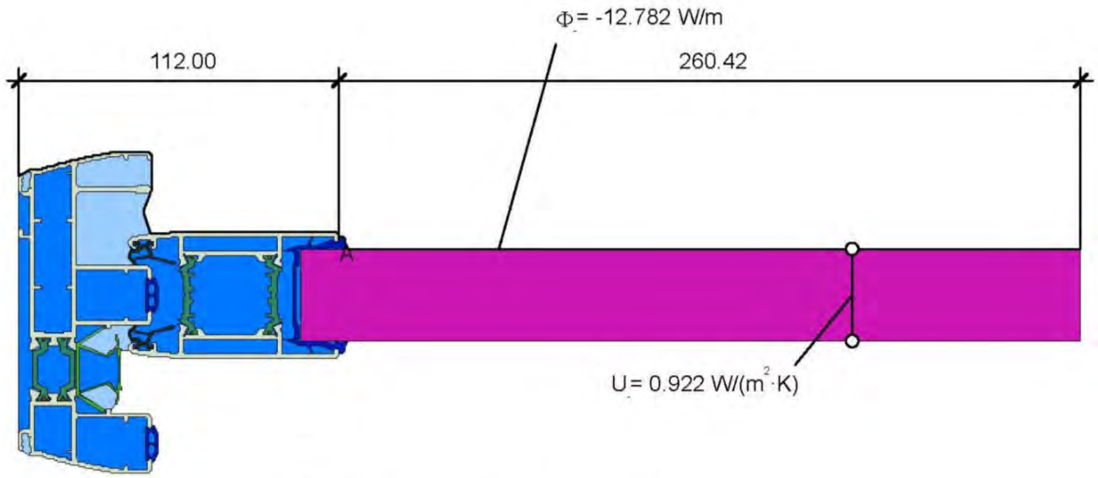
Isotherms - Temperature



Isotherms – Heat Transfer

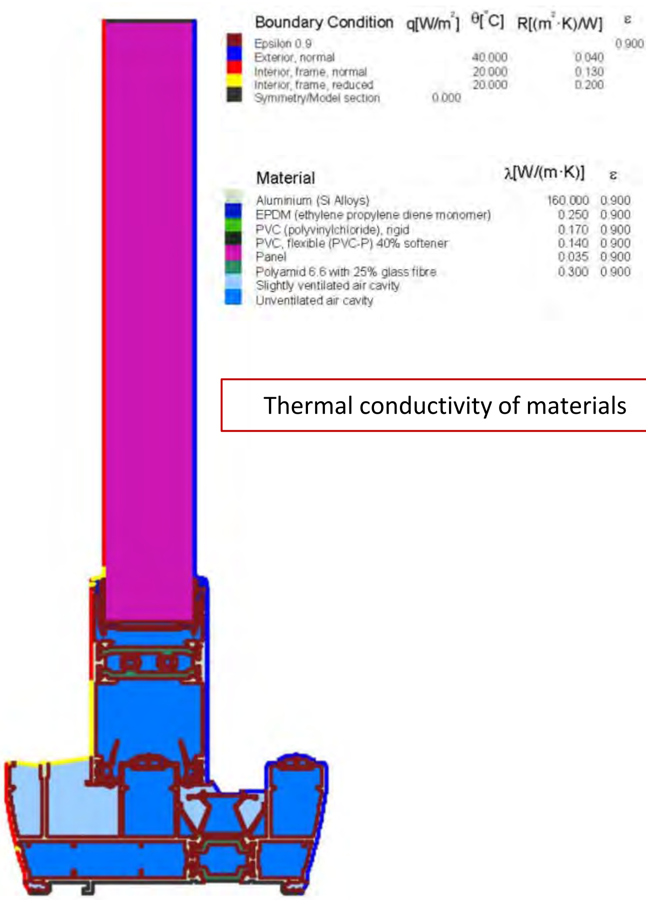


Thermal section transmittance

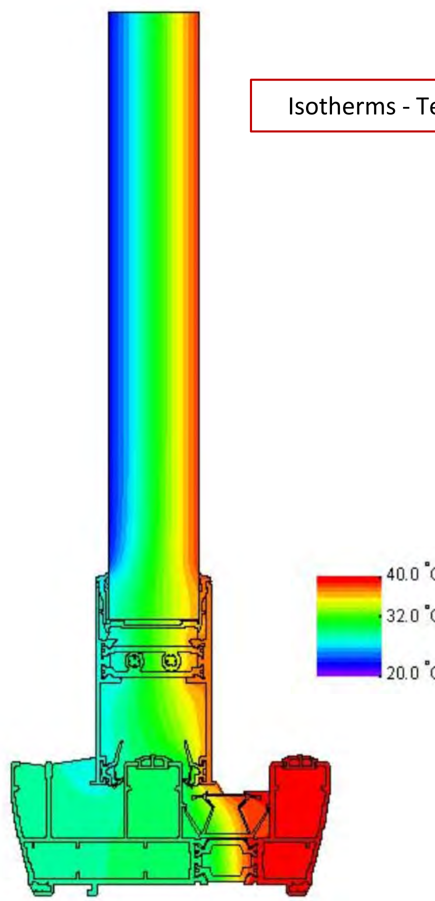


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{12.782}{20.000} - 0.922 \cdot 0.260}{0.112} = \boxed{3.56\ W/(m^2 \cdot K)}$$

4.3.3 Calculation of Thermal Transmittance of Section 04

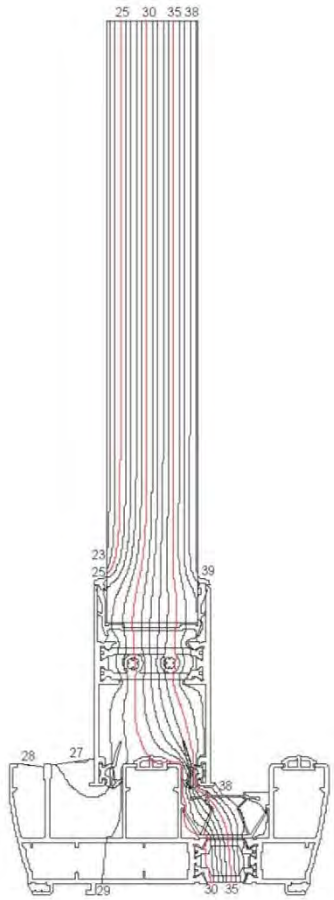


Thermal conductivity of materials

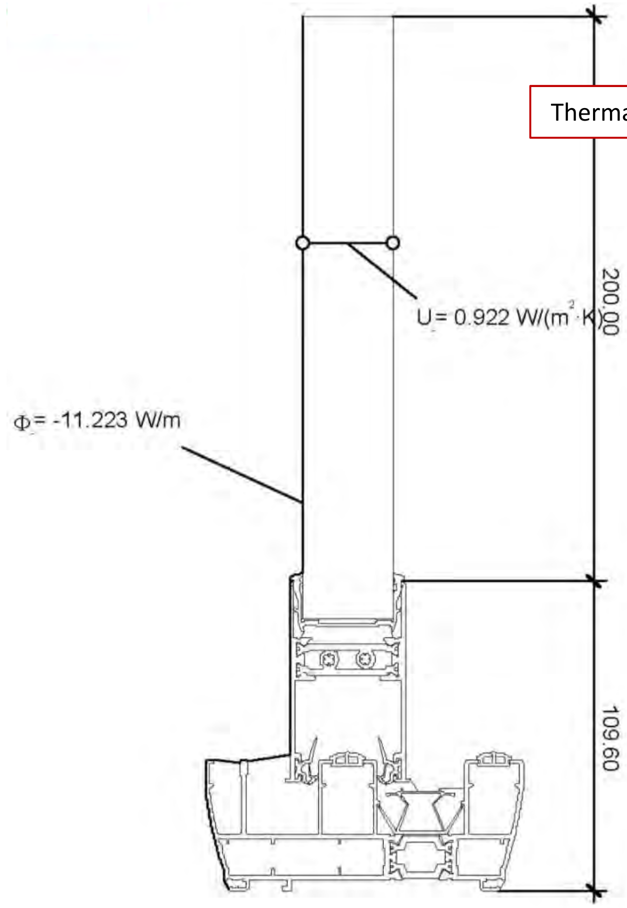


Isotherms - Temperature

Isotherms – Heat Transfer

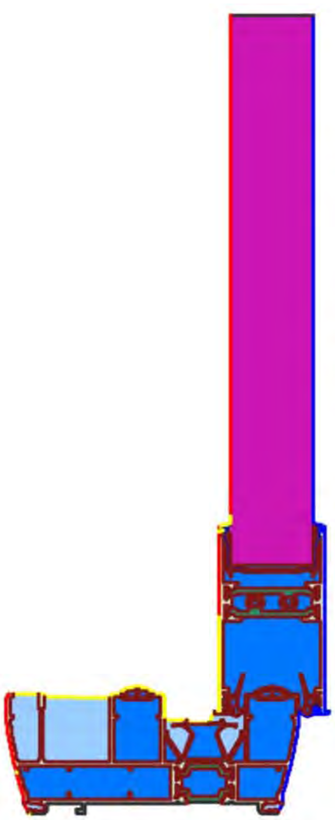


Thermal section transmittance



$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$

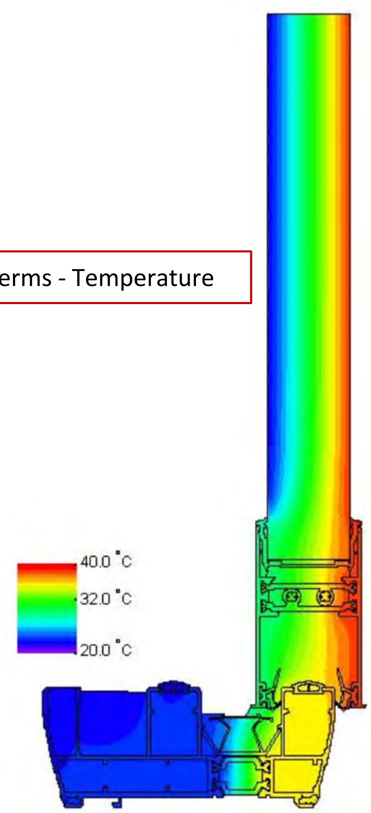
4.3.4 Calculation of Thermal Transmittance of Section 04b



Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

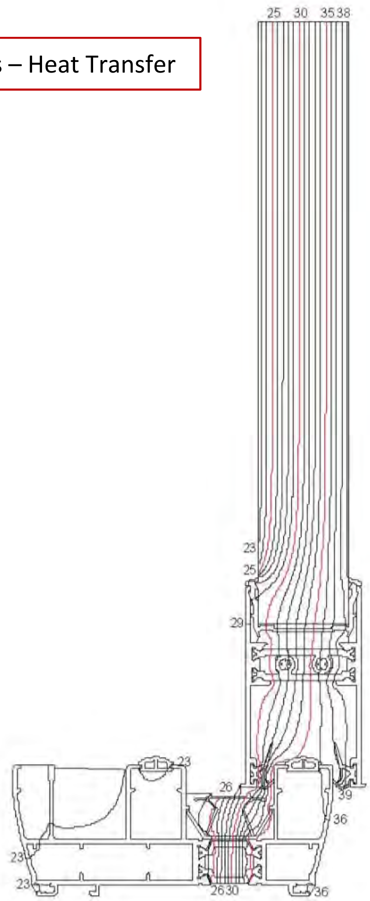
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Isotherms - Temperature

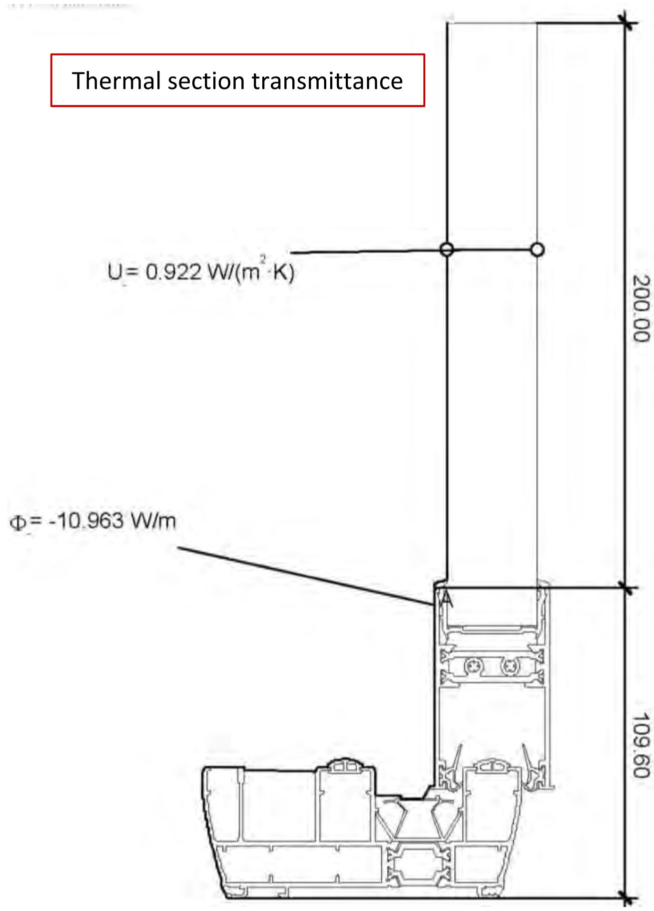


Thermal conductivity of materials

Isotherms – Heat Transfer

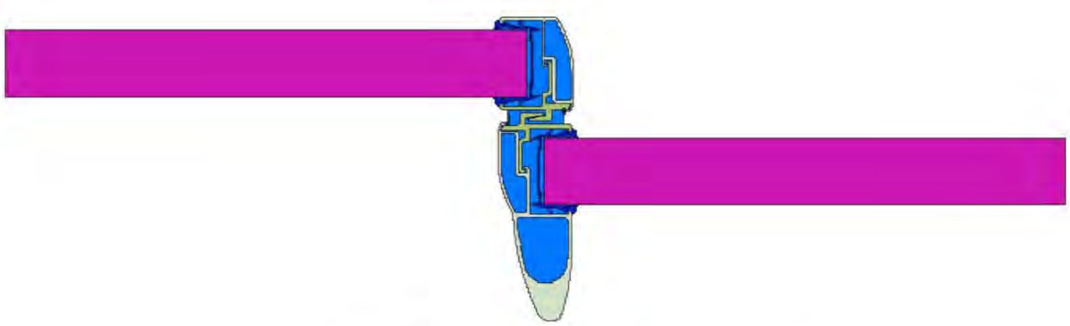


Thermal section transmittance



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{10.963}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.32\ W/(m^2 \cdot K)}$$

4.3.5 Calculation of Thermal Transmittance of Section 05

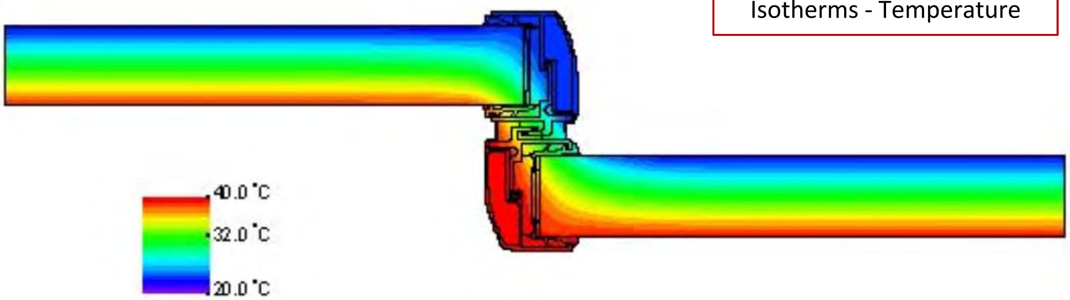


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
PVC-U (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

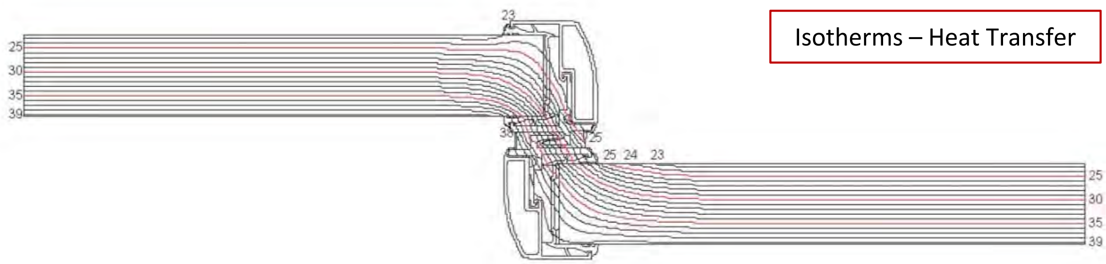
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.90
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

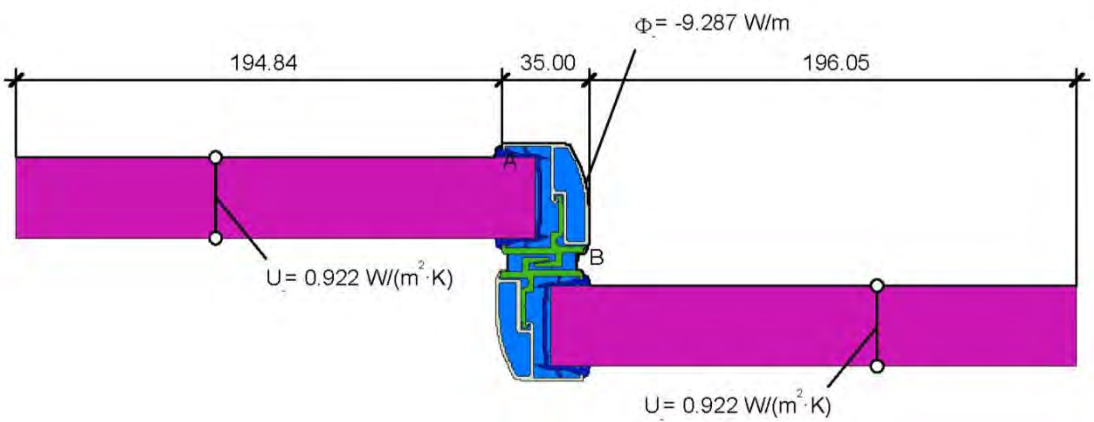
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer



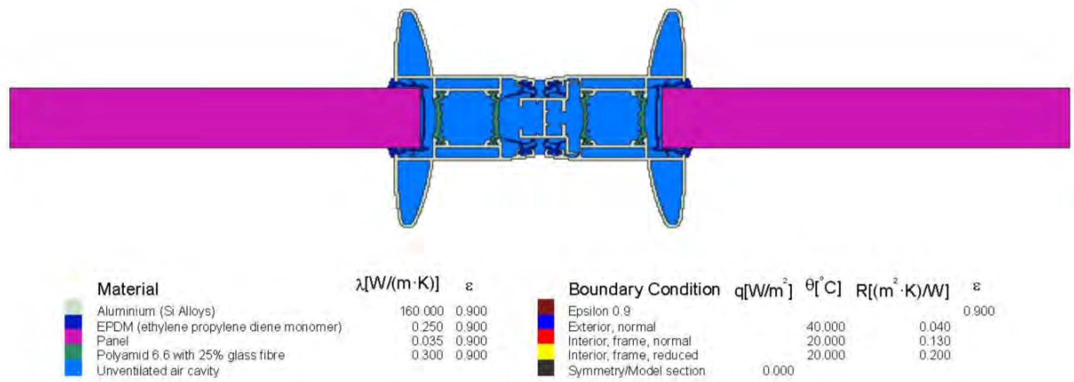


Thermal section transmittance

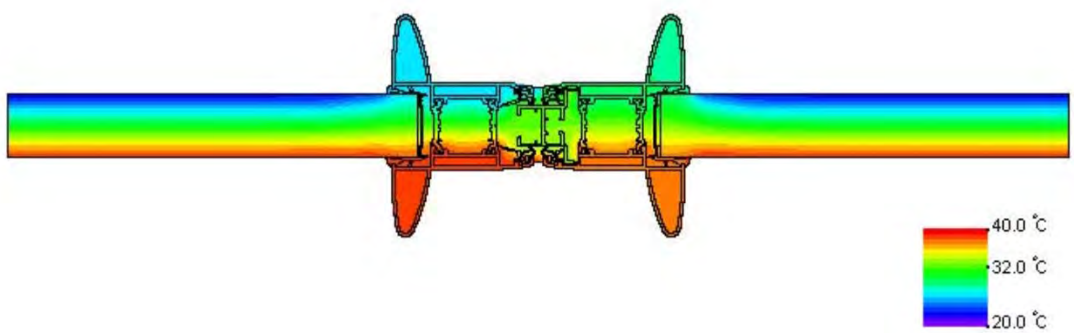
$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97 \text{ W/(m}^2\cdot\text{K)}$$

4.3.6 Calculation of Thermal Transmittance of Section 06

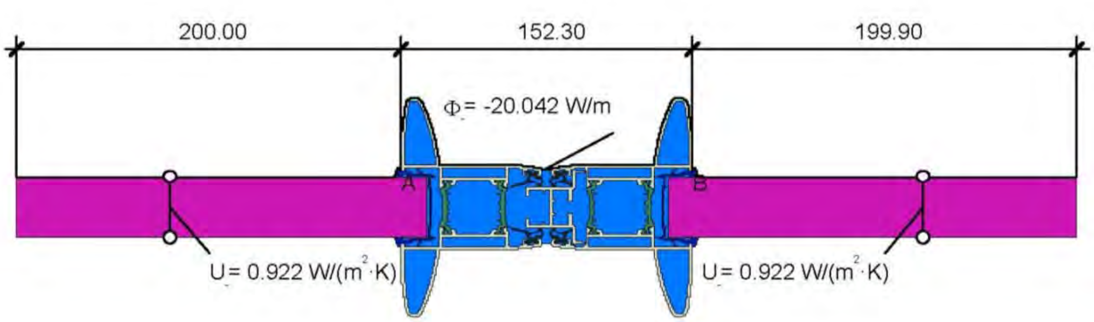
Thermal conductivity of materials



Isotherms - Temperature



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{20.042}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.152} = \boxed{4.16\ W/(m^2 \cdot K)}$$

Thermal transmittance of sliding Doors – 4 Shutters

C- SLIDING DOORS - 4 SHUTTER				
REF.	**LOCATION**	**WIDTH (in mm)**	**HEIGHT (in mm)**	**QTY**
CW-14	MASTER BED	3190	2990	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:
S

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	3.190		Total window Area	in [m²]	9.538
	Height	in[m]	2.990				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.110	Glass area Ag1	Surface / unit	in [m²]	1.975
	Total Frame Area	in [m²]	0.329		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	8.025
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.329		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.560		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	6.915
	Total Frame Area	in [m²]	0.151		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	27.660
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.151		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.320		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.105				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.150	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.449				
	Thermal Transmittance	in [W/m²K]	4.160			in [W/mK]	0.050
Total Frame Area		in [m²]	1.513	Total Glass Area		in [m²]	8.025
S Af*Uf =	3.371	in [W/m²K]					
S Ag*Ug =	9.630	in [W/m²K]					
S Af*Uf =	1.383	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.508**

Thermal transmittance of sliding Doors – 4 Shutters

C- SLIDING DOORS - 4 SHUTTER				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-24	BED ROOM 4	3590	2990	1

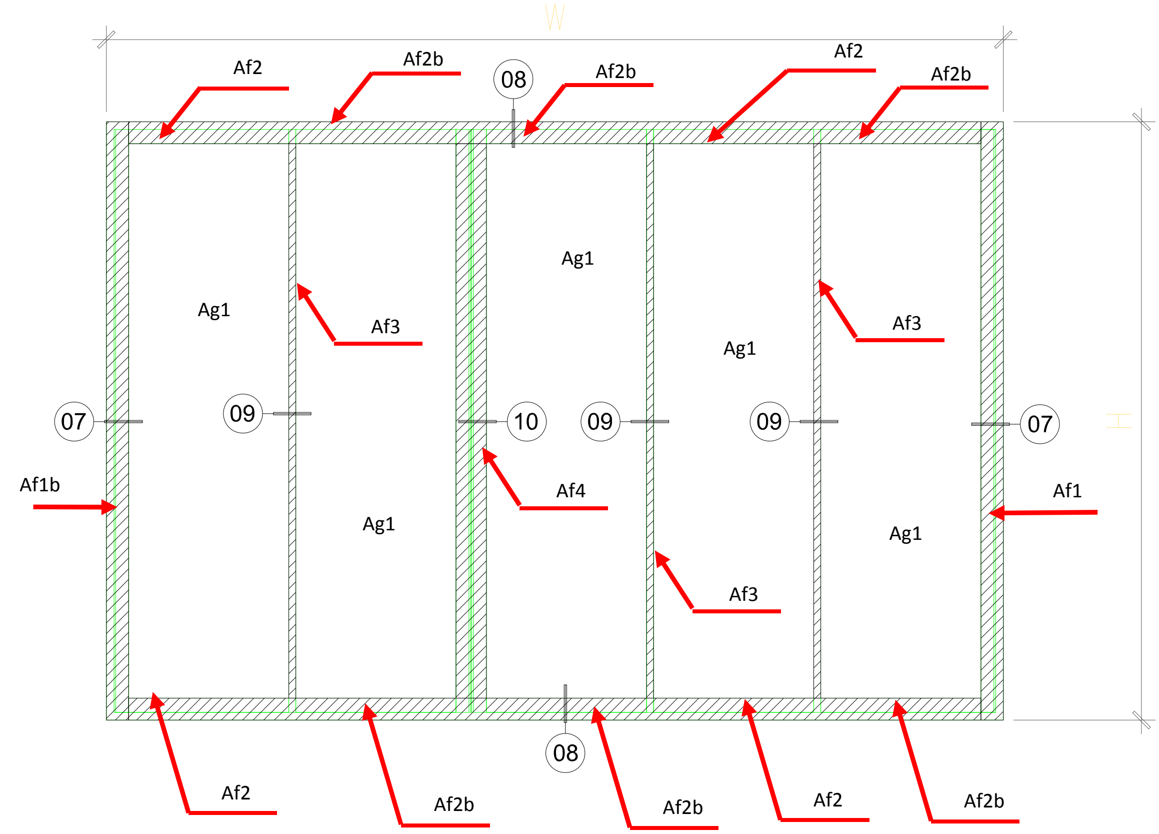
According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

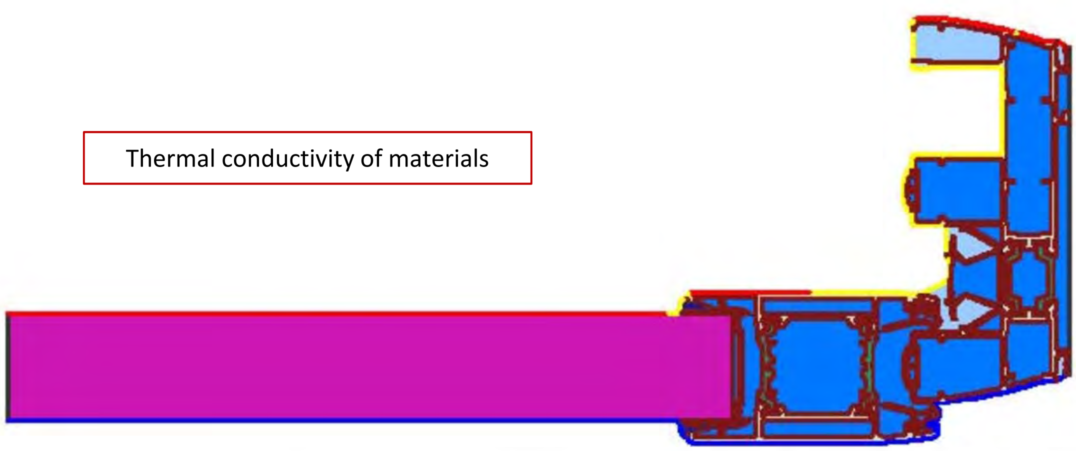
Dimension	Width	in[m]	3.590		Total window Area	in [m²]	10.734
	Height	in[m]	2.990				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.110	Glass area Ag1	Surface / unit	in [m²]	2.263
	Total Frame Area	in [m²]	0.329		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	9.177
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.329		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.560		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.115
	Total Frame Area	in [m²]	0.173		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	28.460
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.173		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.320		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.105				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.150	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.449				
	Thermal Transmittance	in [W/m²K]	4.160			in [W/mK]	0.050
Total Frame Area		in [m²]	1.557	Total Glass Area		in [m²]	9.177
S Af*Uf =	3.520	in [W/m²K]					
S Ag*Ug =	11.012	in [W/m²K]					
S Af*Uf =	1.423	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.486**

4.3 SLIDING DOOR – 5 SHUTTERS:



D- SLIDING DOORS - 5 SHUTTERS				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-13	BED ROOM 01	4490	2990	1
CW-15	BED ROOM 03	4070	2990	1
TOTAL				2

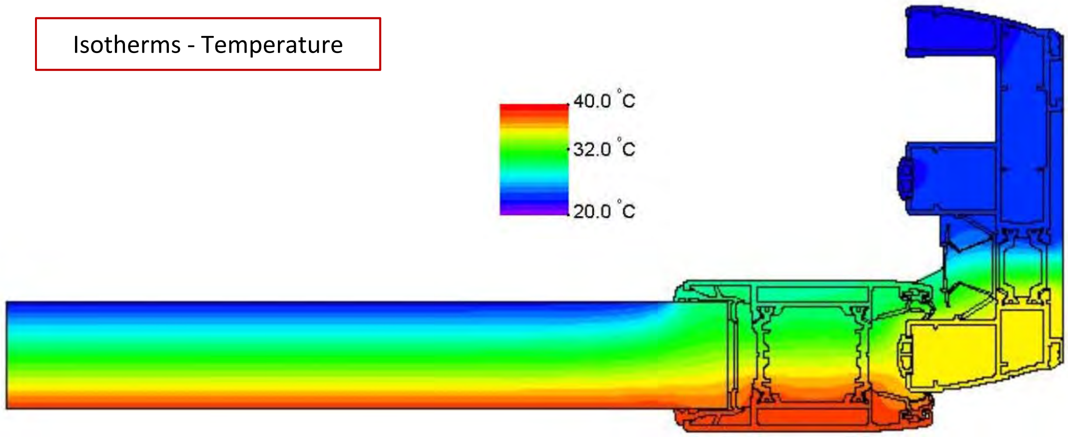
Thermal conductivity of materials



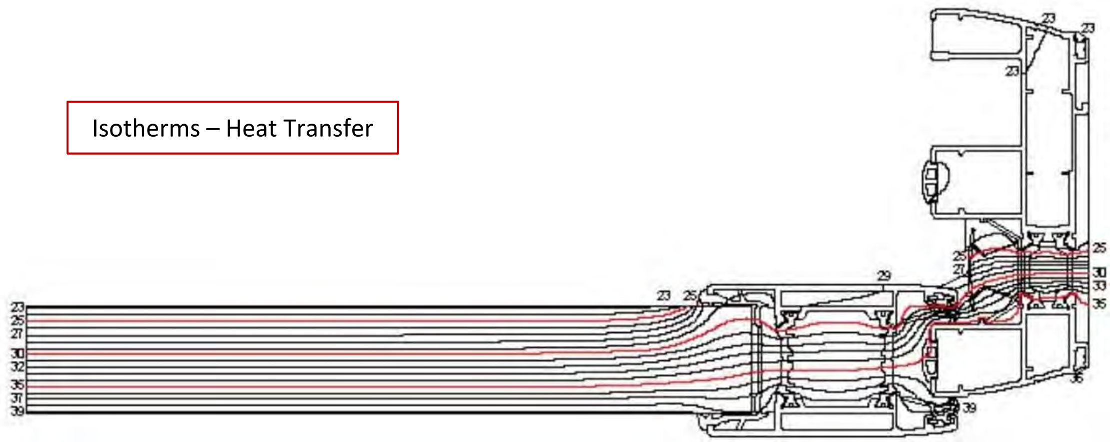
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

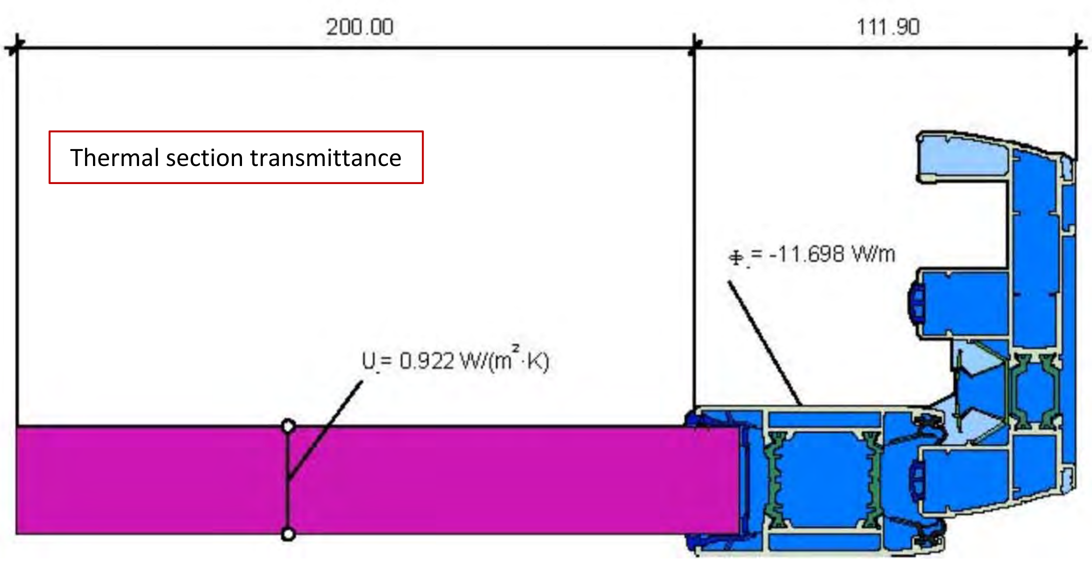
Isotherms - Temperature



Isotherms – Heat Transfer

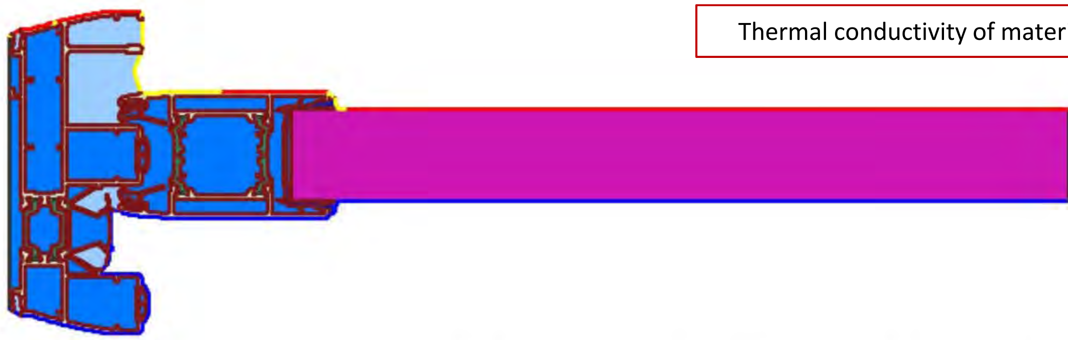


Thermal section transmittance



$$U_{tA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.698}{20.000} - 0.922 \cdot 0.200}{0.112} = \boxed{3.58\ W/(m^2 \cdot K)}$$

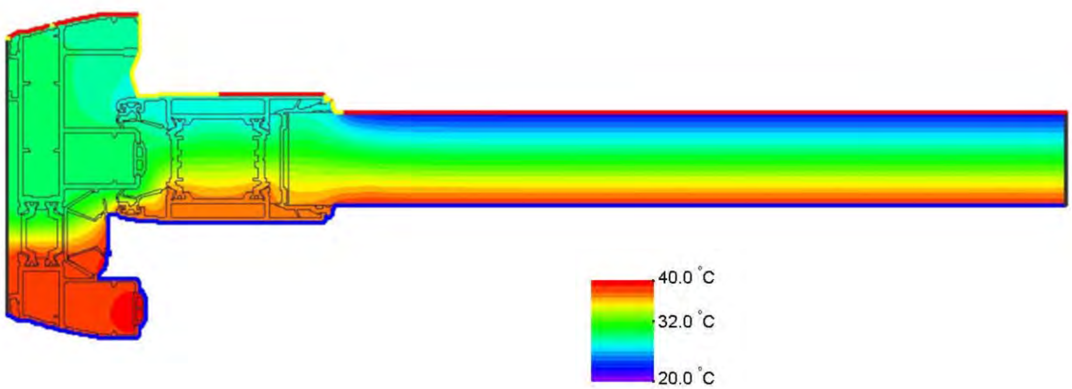
Thermal conductivity of materials



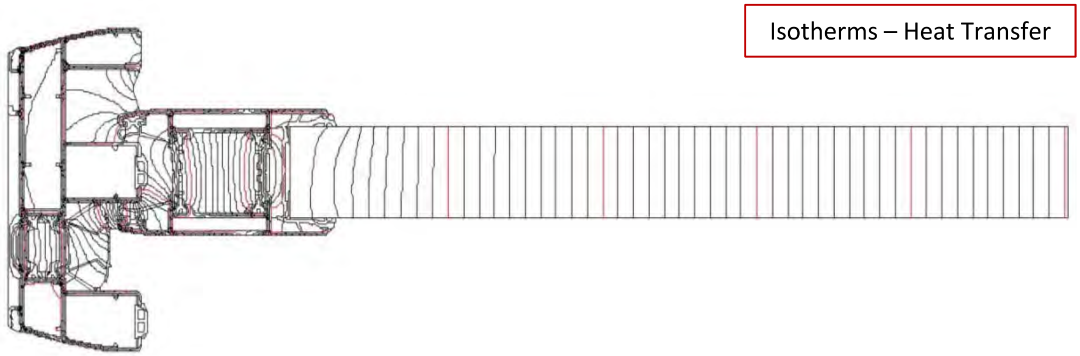
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

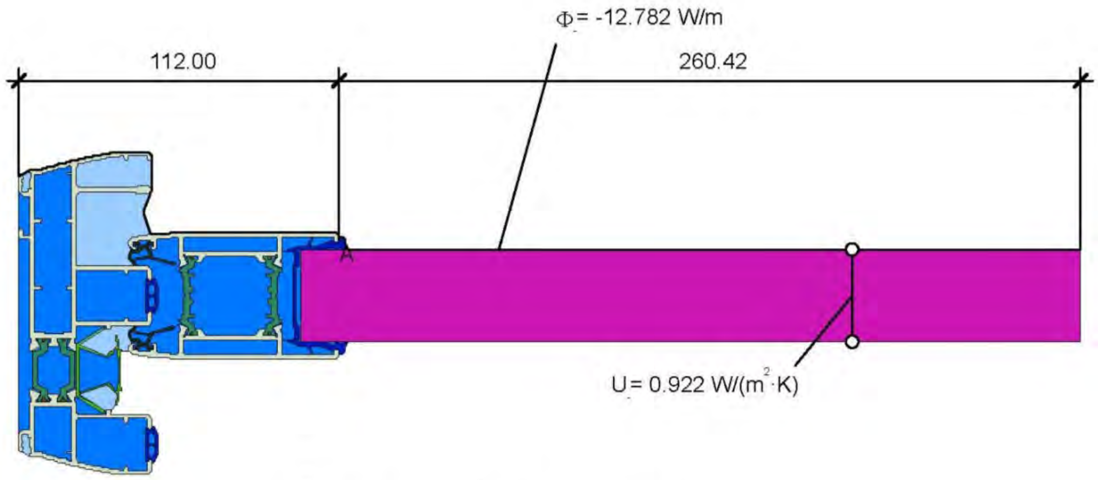
Isotherms - Temperature



Isotherms – Heat Transfer

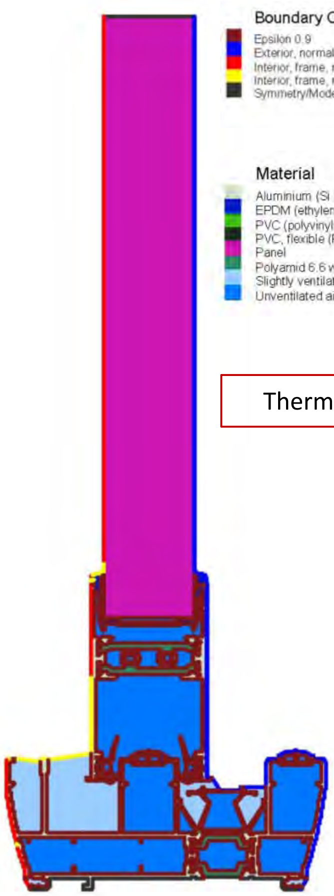


Thermal section transmittance



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{12.782}{20.000} - 0.922 \cdot 0.260}{0.112} = \boxed{3.56\ W/(m^2 \cdot K)}$$

4.3.3 Calculation of Thermal Transmittance of Section 04

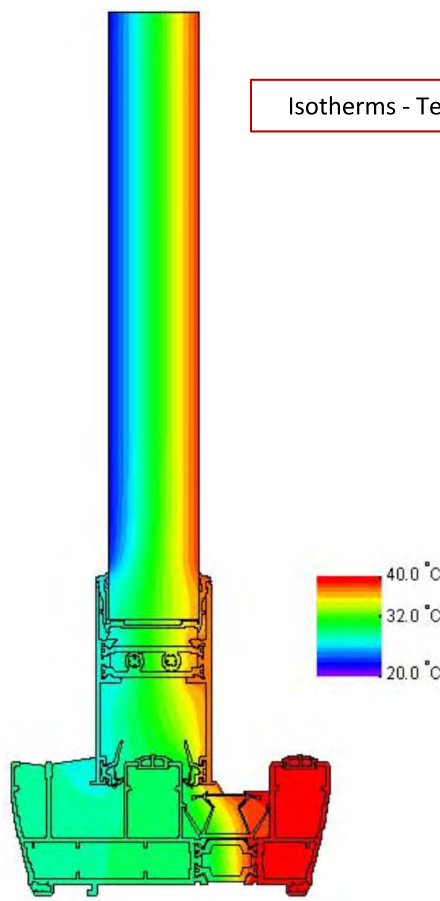


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

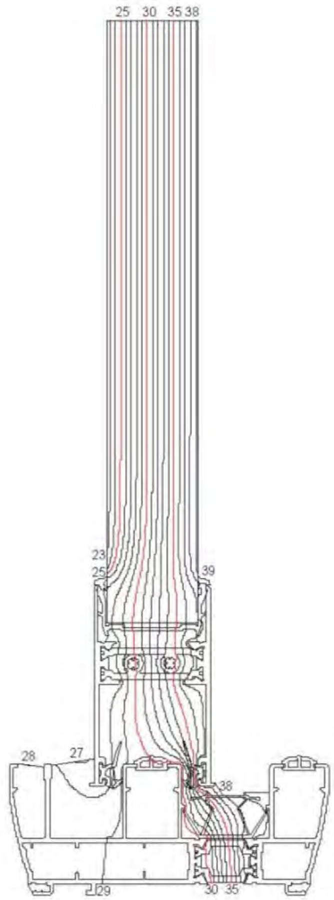
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

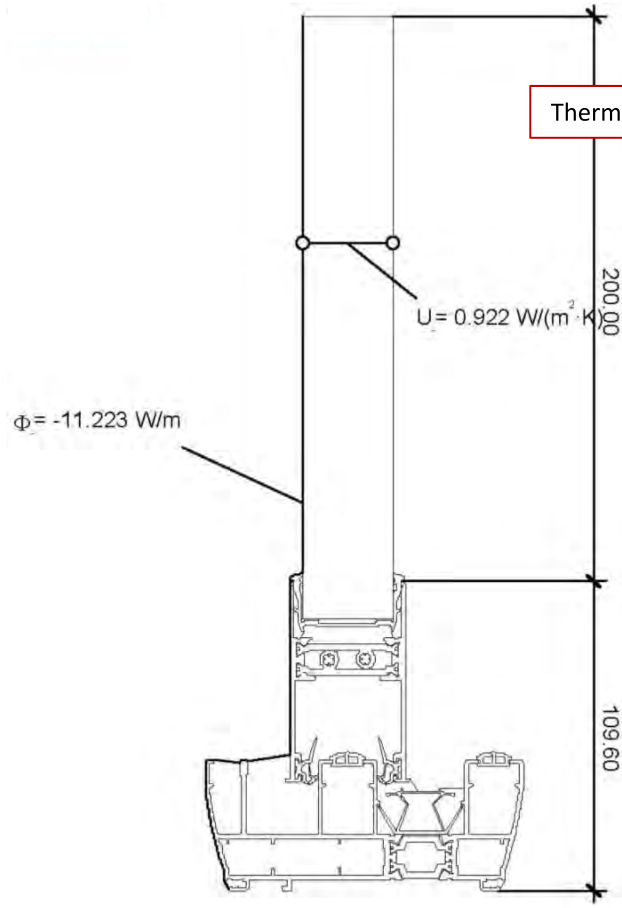
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer

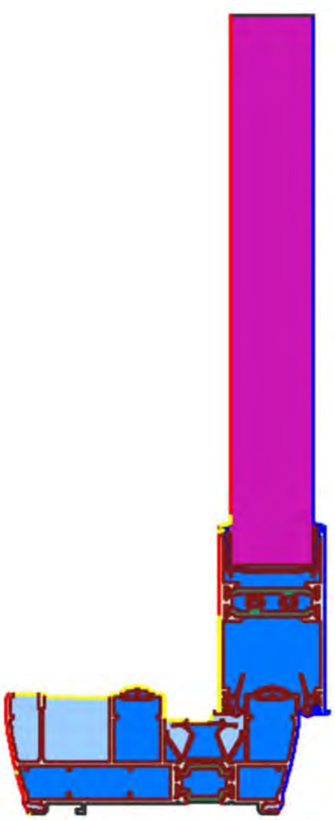




Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$

4.3.4 Calculation of Thermal Transmittance of Section 04b

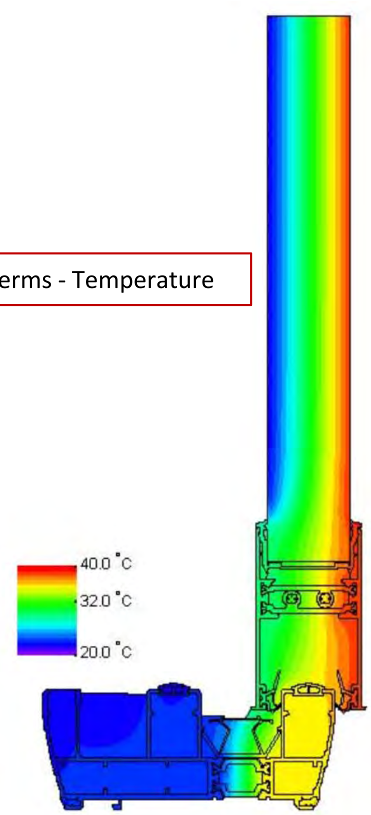


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

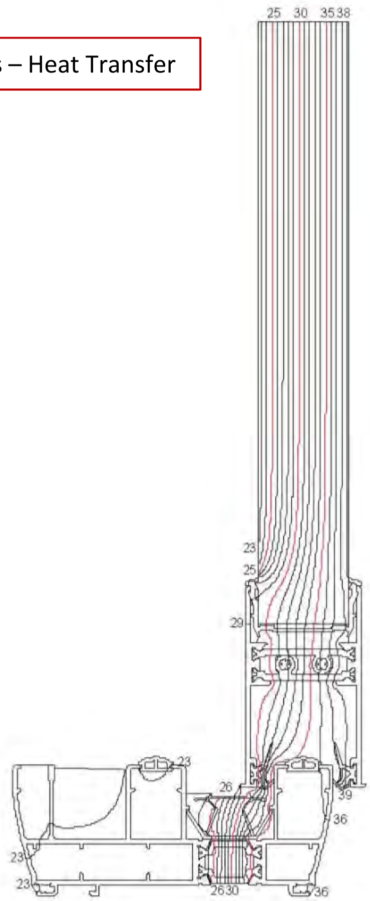
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Thermal conductivity of materials

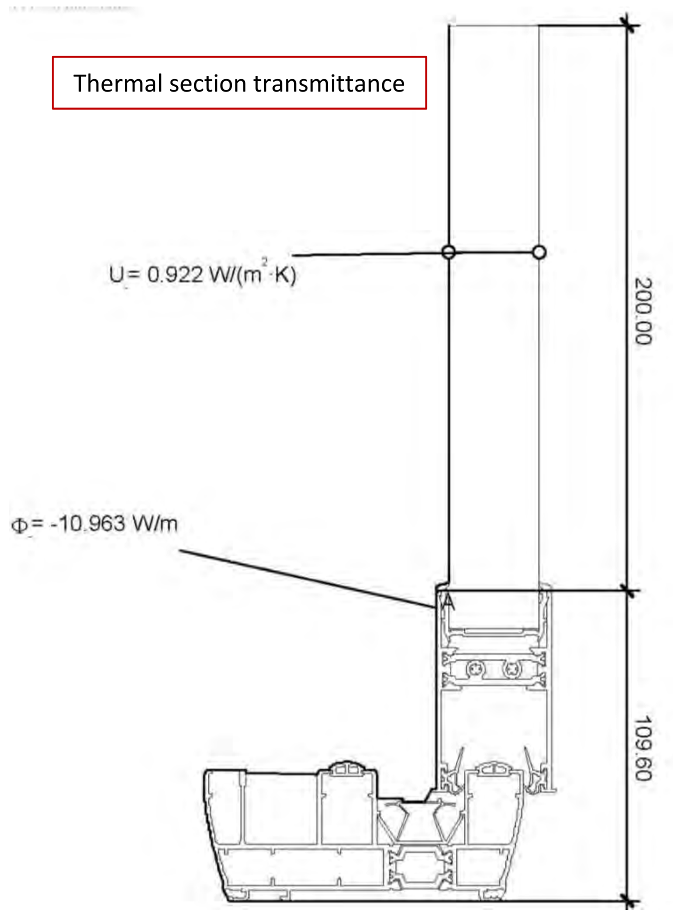
Isotherms - Temperature



Isotherms – Heat Transfer

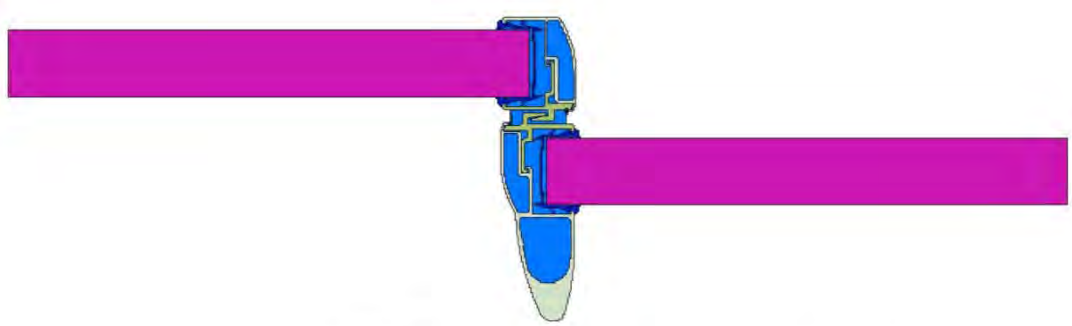


Thermal section transmittance



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{10.963}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.32\ W/(m^2 \cdot K)}$$

4.3.5 Calculation of Thermal Transmittance of Section 05

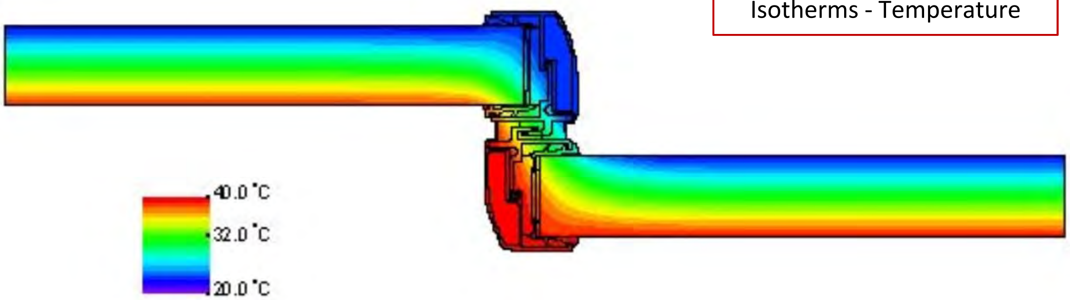


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
PVC-U (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

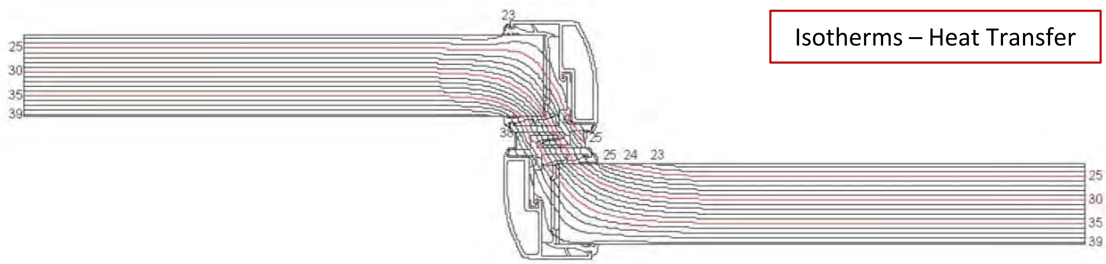
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.90
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

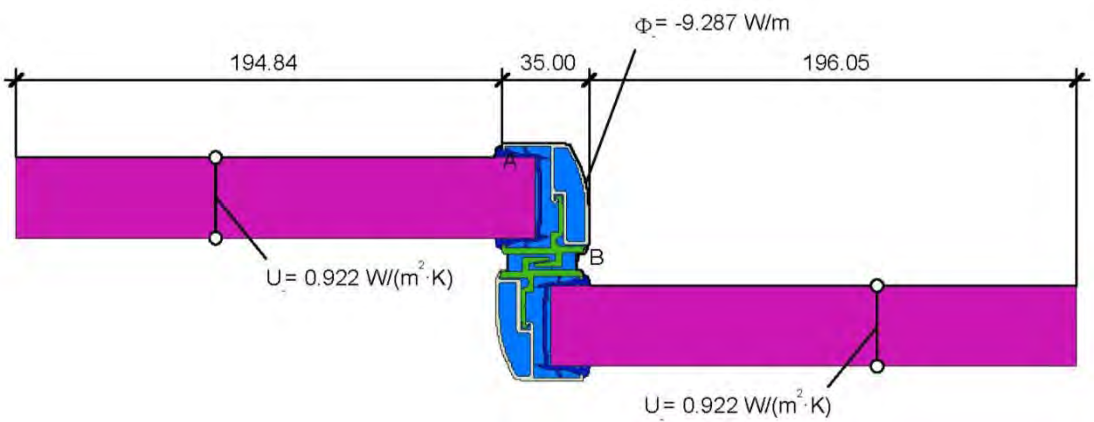
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer



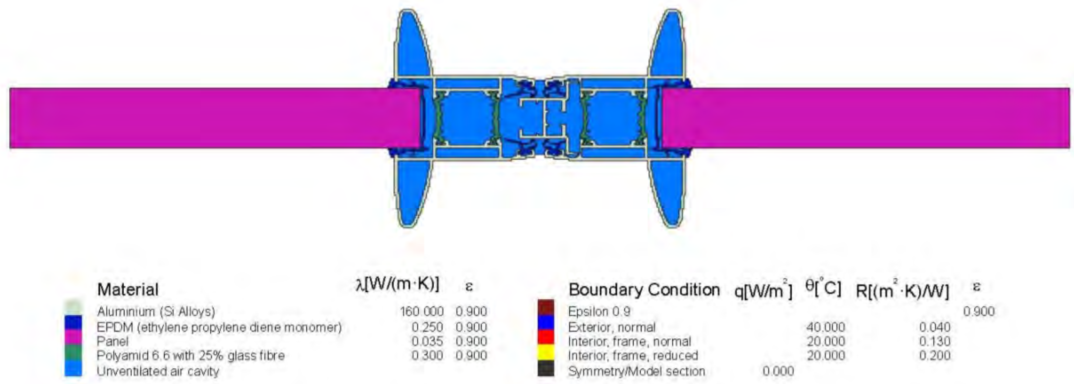


Thermal section transmittance

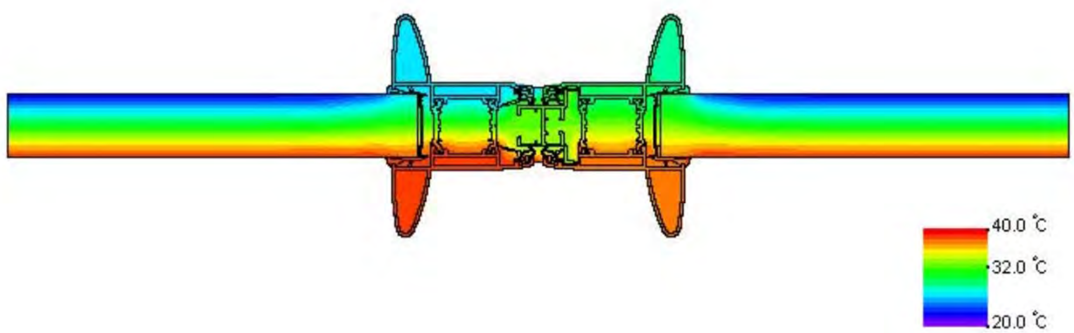
$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97 \text{ W/(m}^2 \cdot \text{K)}$$

4.3.6 Calculation of Thermal Transmittance of Section 06

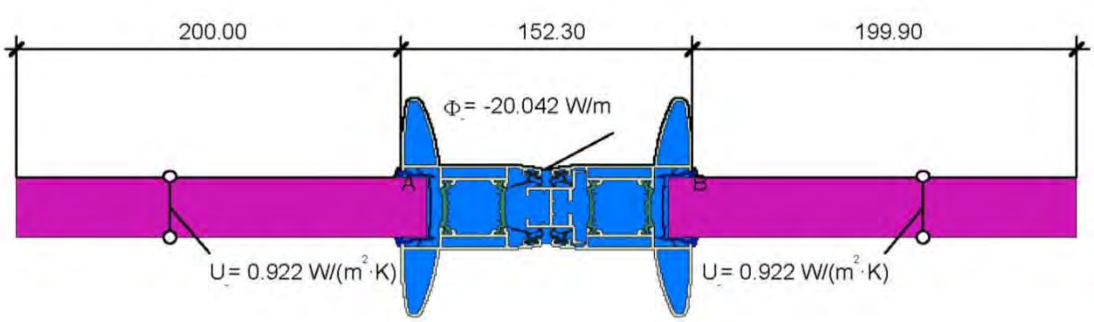
Thermal conductivity of materials



Isotherms - Temperature



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{20.042}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.152} = \boxed{4.16\ W/(m^2 \cdot K)}$$

Thermal transmittance of sliding Doors – 5 Shutters

D- SLIDING DOORS - 5 SHUTTERS				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-13	BED ROOM 01	4490	2990	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:
S

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	4.490		Total window Area	in [m²]	13.425
	Height	in[m]	2.990				
	Aluminium Frame			Glass Area			
	Description	Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.110	Glass area Ag1	Surface / unit	in [m²]	2.287
	Total Frame Area	in [m²]	0.329		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	11.559
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.329		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.560		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	6.052
	Total Frame Area	in [m²]	0.223		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	30.260
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.223		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	3.320		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.314				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.150	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.449				
	Thermal Transmittance	in [W/m²K]	4.160			in [W/mK]	0.050
Total Frame Area		in [m²]	1.866	Total Glass Area		in [m²]	11.559
S Af*Uf =	3.854	in [W/m²K]					
S Ag*Ug =	13.871	in [W/m²K]					
S Af*Uf =	1.513	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.433**

Thermal transmittance of sliding Doors – 5 Shutters

D- SLIDING DOORS - 5 SHUTTERS				
REF.	**LOCATION**	**WIDTH (in mm)**	**HEIGHT (in mm)**	**QTY**
CW-15	BED ROOM 03	4070	2990	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:
S

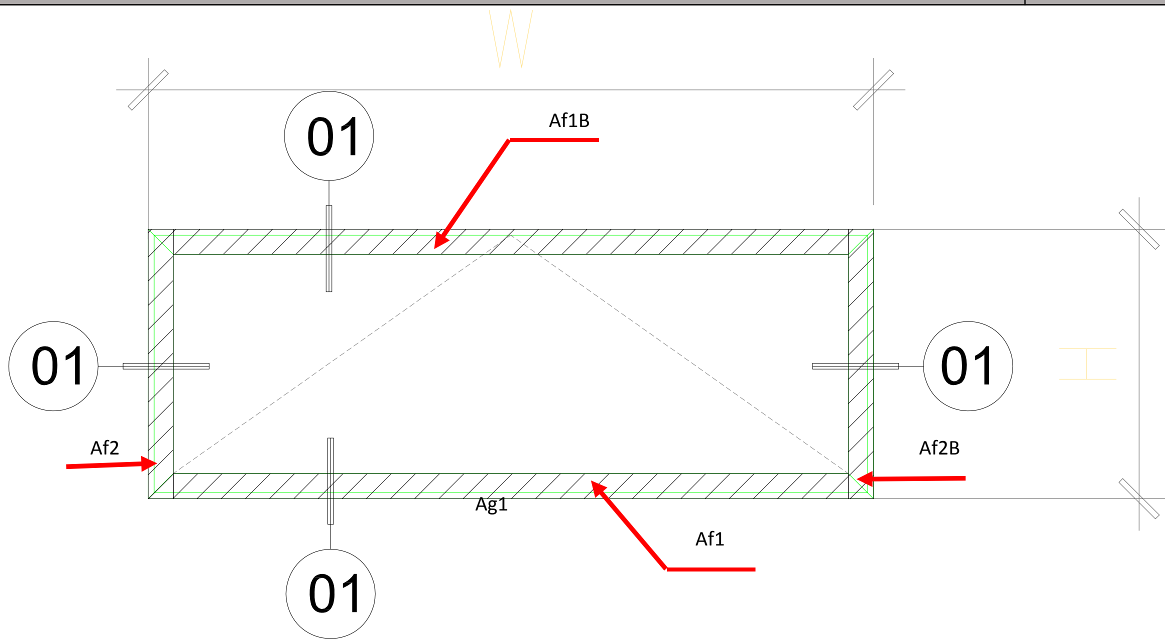
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

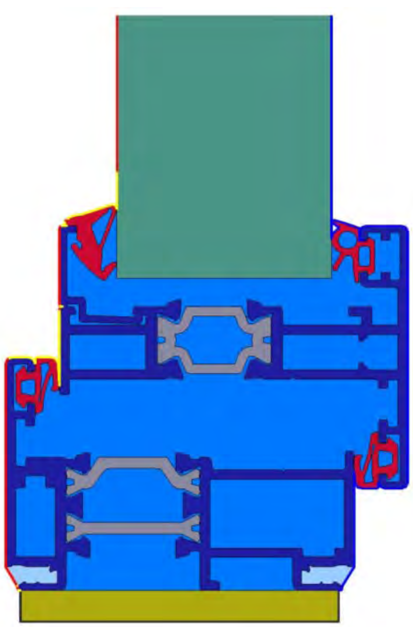
Dimension	Width	in[m]	4.070		Total window Area	in [m^2]	12.169
	Height	in[m]	2.990				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
	Exposed surface	in[m]	0.110		Surface / unit	in [m^2]	2.045
Frame area Af1	Total Frame Area	in [m^2]	0.329	Glass area Ag1	Quantity		5.000
	Thermal Transmittance	in [W/m^{2}K]	3.580		Total Surface	in [m^2]	10.350
	Exposed surface	in[m]	0.110		Surface / unit	in [m^2]	0.000
Frame area Af1b	Total Frame Area	in [m^2]	0.329	Glass area Ag2	Quantity		0.000
	Thermal Transmittance	in [W/m^{2}K]	3.560		Total Surface	in [m^2]	0.000
	Exposed surface	in[m]	0.110		Perimeter/Unit	in[m]	5.884
Frame area Af2	Total Frame Area	in [m^2]	0.200	Perimeter Glass Area Ag1	Quantity		5.000
	Thermal Transmittance	in [W/m^{2}K]	3.440		Toal Perimeter	in [m]	29.420
	Exposed surface	in[m]	0.110		Perimeter/Unit	in[m]	0.000
Frame area Af2b	Total Frame Area	in [m^2]	0.200	Perimeter Glass Area Ag2	Quantity		0.000
	Thermal Transmittance	in [W/m^{2}K]	3.320		Toal Perimeter	in [m]	0.000
	Exposed surface	in[m]	0.035				
Frame area Af3	Total Frame Area	in [m^2]	0.314	Glass Thermal Transmittance			
	Thermal Transmittance	in [W/m^{2}K]	0.000			in [W/m^{2}K]	1.200
	Exposed surface	in[m]	0.150				
Frame area Af4	Total Frame Area	in [m^2]	0.449	Linear Thermal Transmittance			
	Thermal Transmittance	in [W/m^{2}K]	4.160			in [W/mK]	0.050
Total Frame Area		in [m^2]	1.820	Total Glass Area		in [m^2]	10.350
S Af*Uf =	3.698	in [W/m^{2}K]					
S Ag*Ug =	12.420	in [W/m^{2}K]					
S Af*Uf =	1.471	in [W/m^{2}K]		**Thermal Transmittance of window (Uw)**		**in [W/m^{2}K]**	**1.445**

4.4 HINGE WINDOW:

E - HINGED DOOR				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW03	FORMAL WC	1590	590	1
TOTAL				1



4.4.1 Calculation of Thermal Transmittance of Section 01

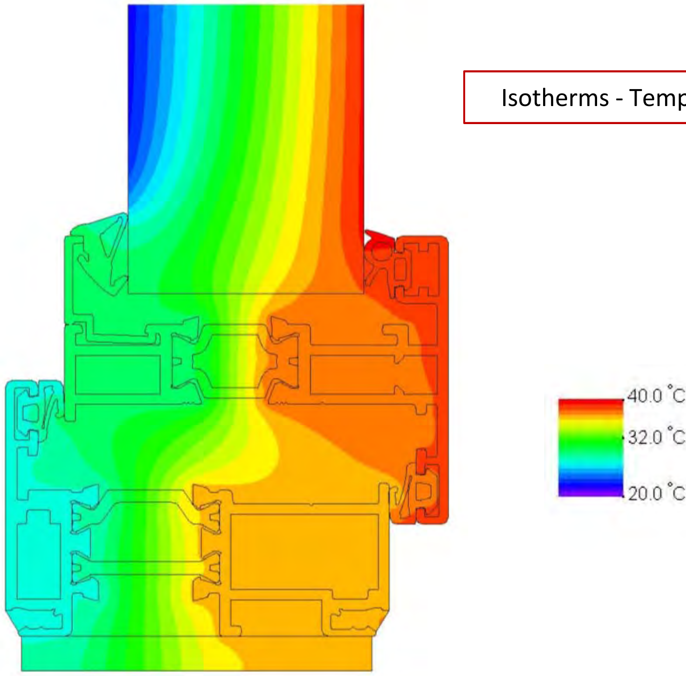


Thermal conductivity of materials

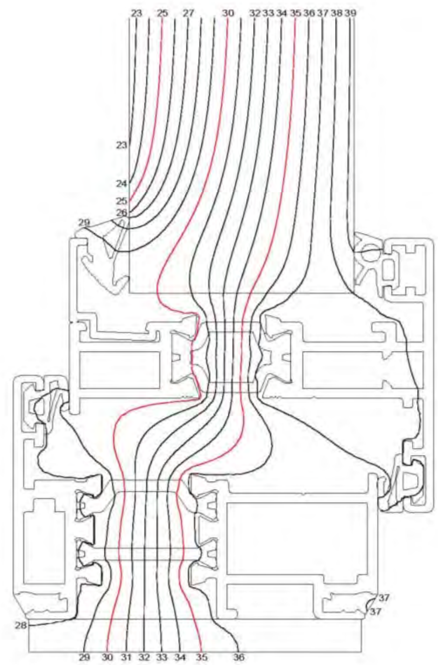
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity	anisotropic	
Unventilated air cavity	anisotropic	

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

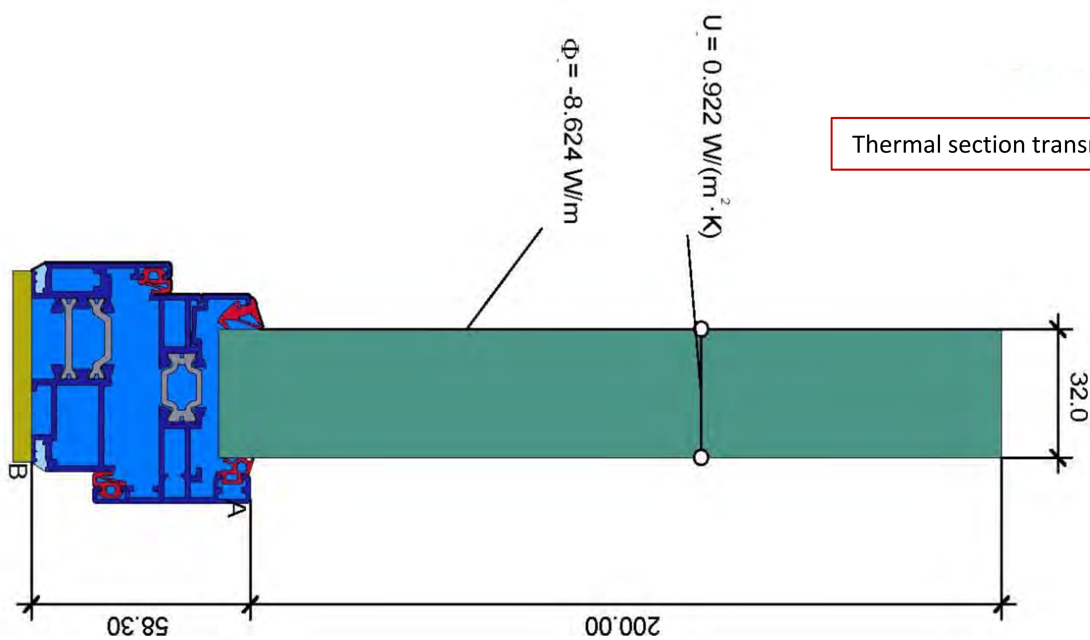
Isotherms - Temperature



Isotherms – Heat Transfer



Thermal section transmittance



$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.624}{20.000} - 0.922 \cdot 0.200}{0.058} = \boxed{4.23\ W/(m^2 \cdot K)}$$

Thermal transmittance of Hinged Window

E - HINGED WINDOW				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-03	FORMAL WC	1590	590	1
TOTAL				1

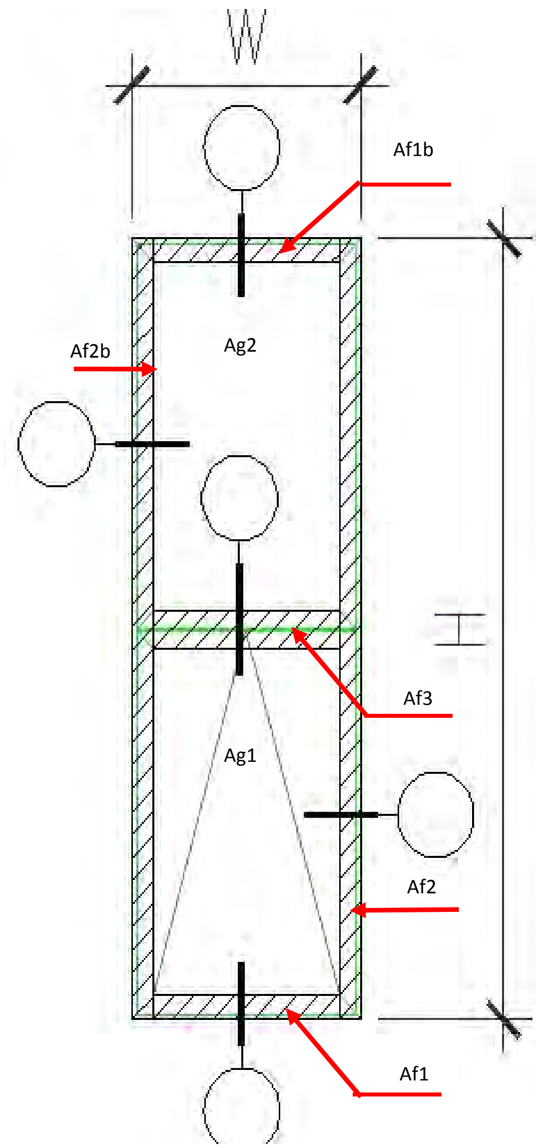
According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

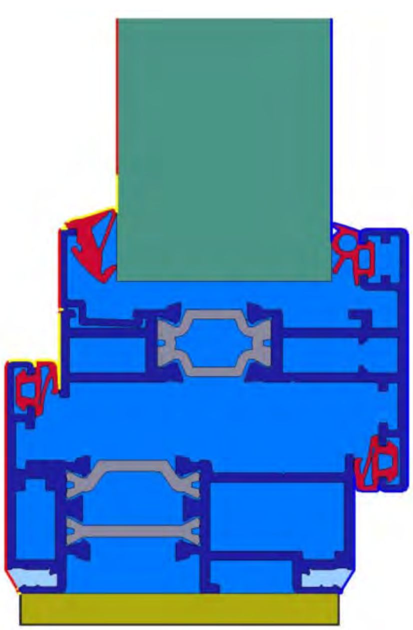
Dimension	Width	in[m]	1.590		Total window Area	in [m²]	0.938
	Height	in[m]	0.590				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.055	Glass area Ag1	Surface / unit	in [m²]	0.722
	Total Frame Area	in [m²]	0.175		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Total Surface	in [m²]	0.722
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.055	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	3.920
	Total Frame Area	in [m²]	0.041		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.150		Toal Perimeter	in [m]	3.920
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	3.265
	Total Frame Area	in [m²]	0.000		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	3.265
Frame area Af3	Exposed surface	in[m]	0.000	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.216	Total Glass Area		in [m²]	0.722
S Af*Uf =	0.909	in [W/K]					
S Ag*Ug =	0.867	in [W/K]					
S Af*Uf =	0.35925	in [W/K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**2.276**

4.6 TOP HUNG WINDOWS WITH FIXED:



F- TOP HUNG WINDOW WITH FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW23	BATH 4 & 1	590	1790	2
GW-04	DRIVER BATH	590	2390	1
GW04 A	DRIVER ROOM	590	2390	1
GW04 B	MAIDS ROOM	590	2390	1
GW04 C	FAMILY WC, GUEST BATH	590	2390	2
GW - 05	MASTER BATH	1590	1790	1
TOTAL				8

4.6.1 Calculation of Thermal Transmittance of Section 01

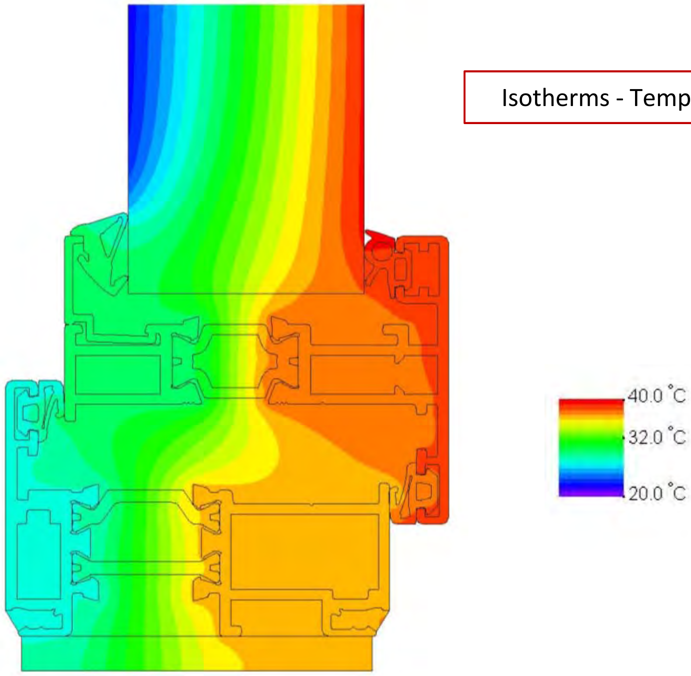


Thermal conductivity of materials

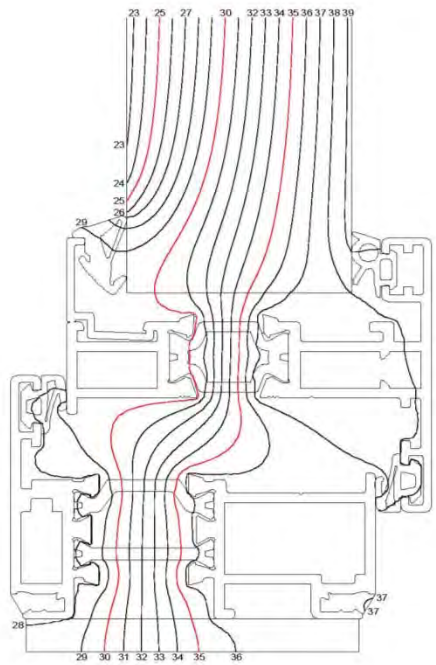
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity	anisotropic	
Unventilated air cavity	anisotropic	

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

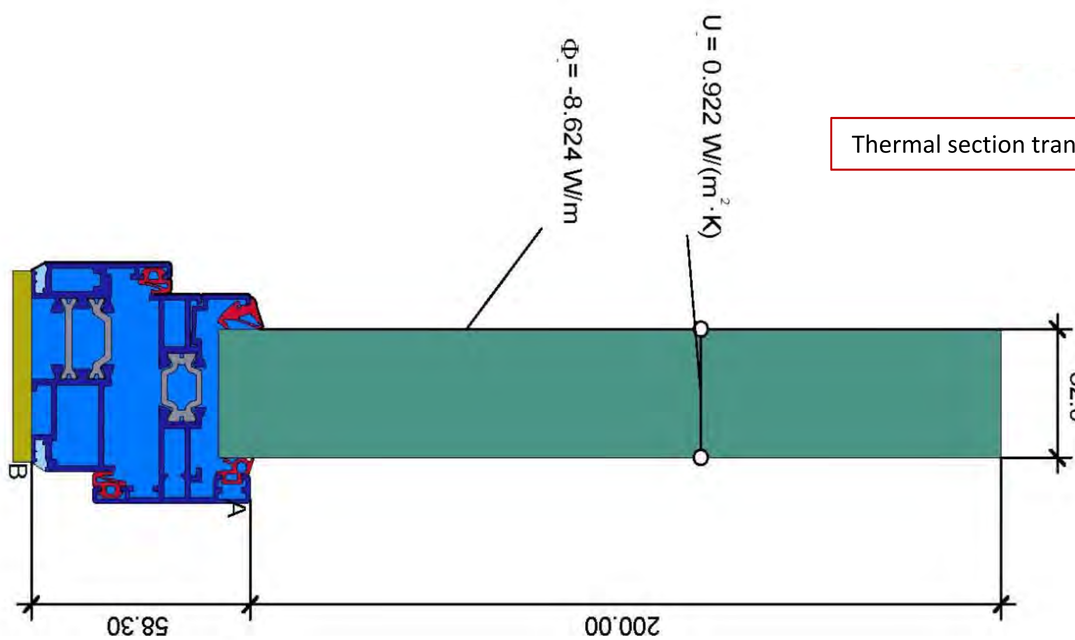
Isotherms - Temperature



Isotherms – Heat Transfer



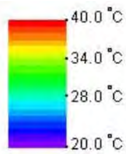
Thermal section transmittance

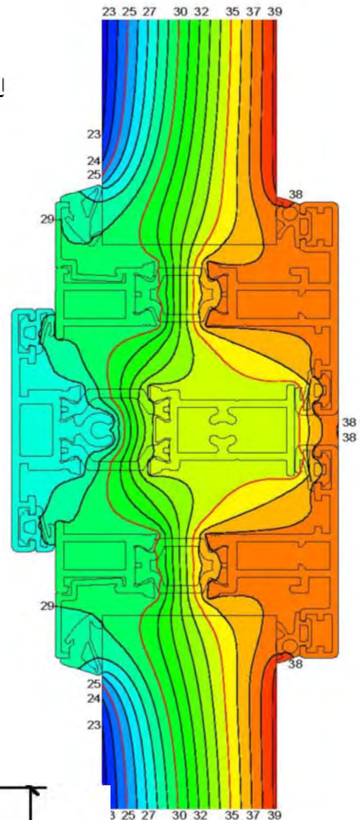


$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.624}{20.000} - 0.922 \cdot 0.200}{0.058} = \boxed{4.23\ W/(m^2 \cdot K)}$$

4.4.2 Calculation of Thermal Transı

Isotherms - Temperature

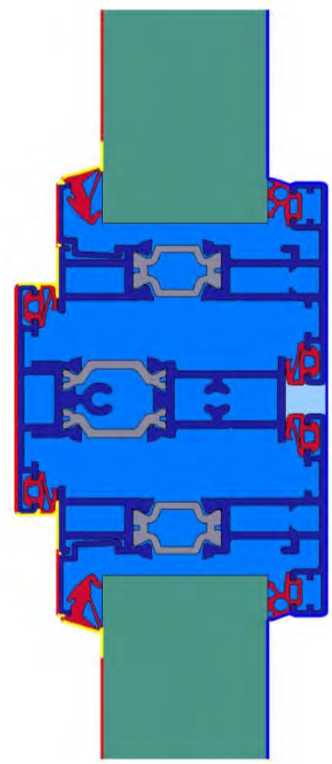


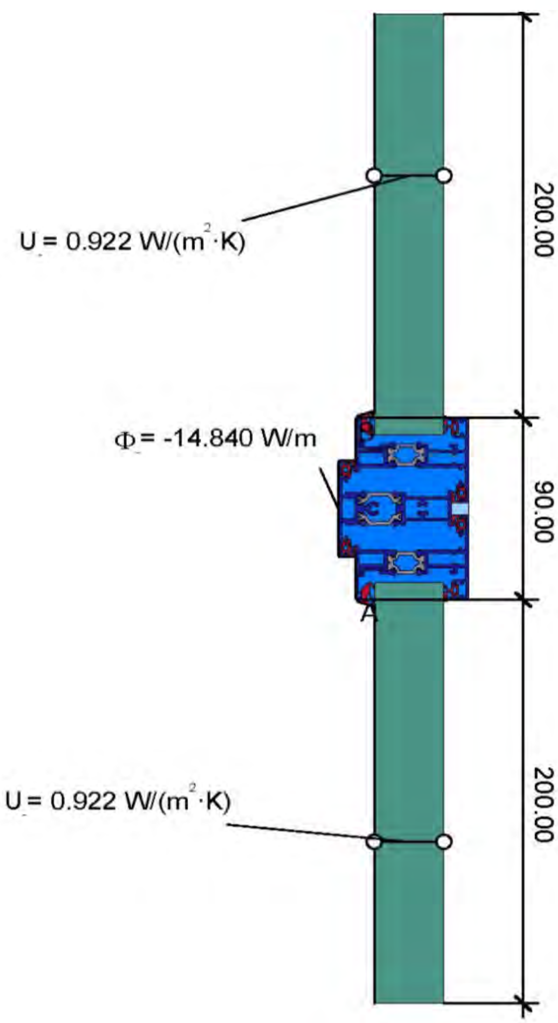


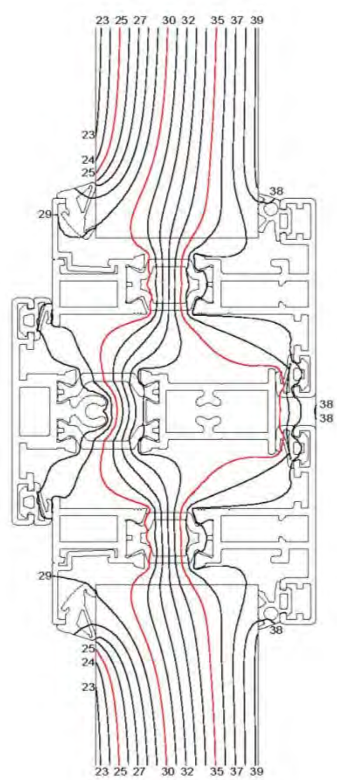
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity	anisotropic	
Unventilated air cavity	anisotropic	

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Thermal conductivity of materials







Isotherms – Heat Transfer

Thermal section transmittance

$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\frac{14.840}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.090} = \boxed{4.15\ W/(m^2\cdot K)}$$

Thermal transmittance of Top Hung Windows With Fixed

G- TOP HUNG WINDOW WITH FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-02	BATH-01 & 04	590	1790	2

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	0.590		Total window Area	in [m²]	1.056
	Height	in[m]	1.790				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.058	Glass area Ag1	Surface / unit	in [m²]	0.371
	Total Frame Area	in [m²]	0.055		Quantity		2.000
	Thermal Transmittance	in [W/m²K]	4.230		Total Surface	in [m²]	0.741
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.058	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	3.880
	Total Frame Area	in [m²]	0.208		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Toal Perimeter	in [m]	3.880
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	2.465
	Total Frame Area	in [m²]	0.000		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	2.465
Frame area Af3	Exposed surface	in[m]	0.090	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.055				
	Thermal Transmittance	in [W/m²K]	4.150			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.318	Total Glass Area		in [m²]	0.741
S Af*Uf =	1.339	in [W/K]					
S Ag*Ug =	0.889	in [W/K]					
S Af*Uf =	0.31725	in [W/K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**2.404**

Thermal transmittance of Top Hung Windows With Fixed

G- TOP HUNG WINDOW WITH FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-04	DRIVER BATH	590	2390	1
GW-04A	DRIVER ROOM	590	2390	1
GW-04B	MAIND ROOM	590	2390	1
GW-04C	FAMILY WC, GUEST WC	590	2390	2

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	0.590		Total window Area	in [m²]	1.410
	Height	in[m]	2.390				
Aluminium Frame				Glass Area			
	Description	Unit	Value		Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.058	Glass area Ag1	Surface / unit	in [m²]	0.512
	Total Frame Area	in [m²]	0.055		Quantity		2.000
	Thermal Transmittance	in [W/m²K]	4.230		Total Surface	in [m²]	1.023
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.058	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	5.080
	Total Frame Area	in [m²]	0.277		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Toal Perimeter	in [m]	5.080
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	3.065
	Total Frame Area	in [m²]	0.000		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	3.065
Frame area Af3	Exposed surface	in[m]	0.090	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.055				
	Thermal Transmittance	in [W/m²K]	4.150			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.387	Total Glass Area		in [m²]	1.023
S Af*Uf =	1.633	in [W/K]					
S Ag*Ug =	1.228	in [W/K]					
S Af*Uf =	0.40725	in [W/K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**2.317**

Thermal transmittance of Top Hung Windows With Fixed

G- TOP HUNG WINDOW WITH FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-05	MASTER BATH	1590	1790	1

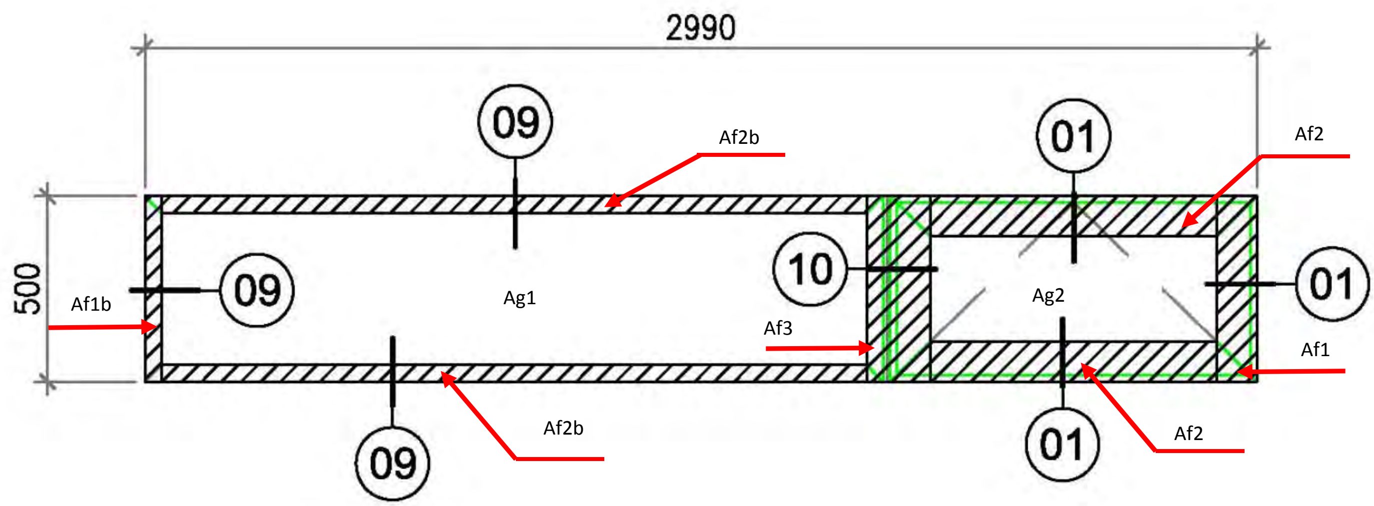
According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	1.590		Total window Area	in [m²]	2.846
	Height	in[m]	1.790				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.058	Glass area Ag1	Surface / unit	in [m²]	1.158
	Total Frame Area	in [m²]	0.104		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Total Surface	in [m²]	1.158
Frame area Af1b	Exposed surface	in[m]	0.058	Glass area Ag2	Surface / unit	in [m²]	1.158
	Total Frame Area	in [m²]	0.104		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Total Surface	in [m²]	1.158
Frame area Af2	Exposed surface	in[m]	0.058	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	4.750
	Total Frame Area	in [m²]	0.092		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Toal Perimeter	in [m]	4.750
Frame area Af2b	Exposed surface	in[m]	0.058	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	4.750
	Total Frame Area	in [m²]	0.092		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230		Toal Perimeter	in [m]	4.750
Frame area Af3	Exposed surface	in[m]	0.080	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.127				
	Thermal Transmittance	in [W/m²K]	4.150			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.519	Total Glass Area		in [m²]	2.315
S Af*Uf =	2.186	in [W/K]					
S Ag*Ug =	2.778	in [W/K]					
S Af*Uf =	0.475	in [W/K]		Thermal Transmittance of window (Uw)		in [W/m²K]	1.919

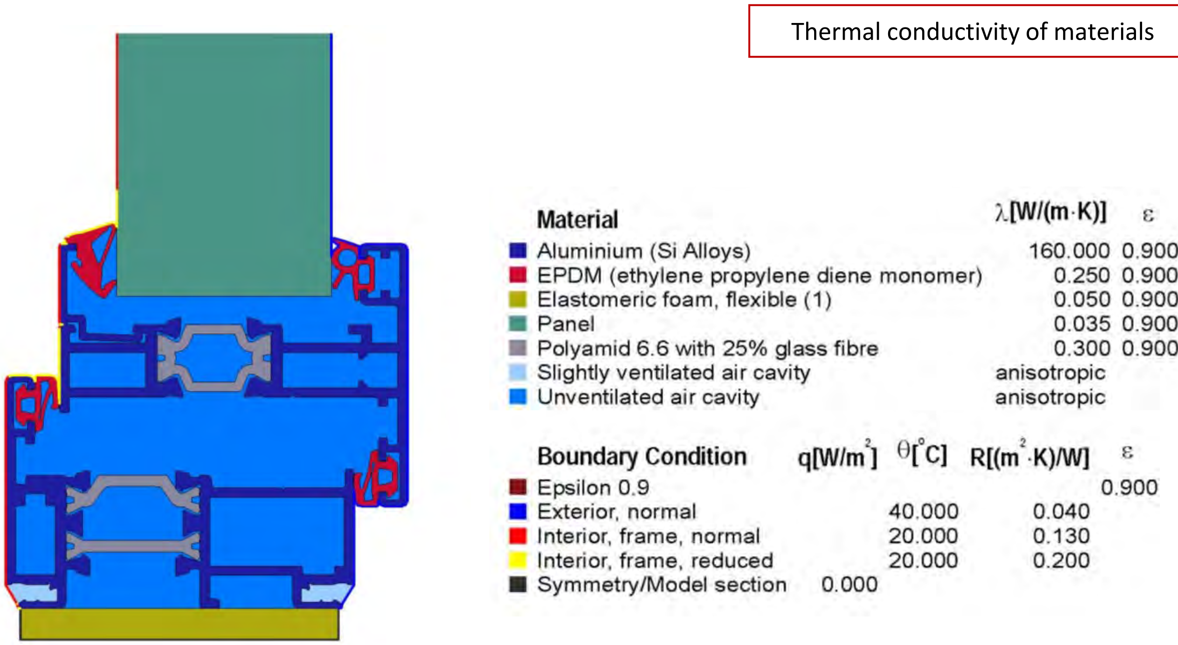
4.6 COMBINED WINDOW (KITCHEN)

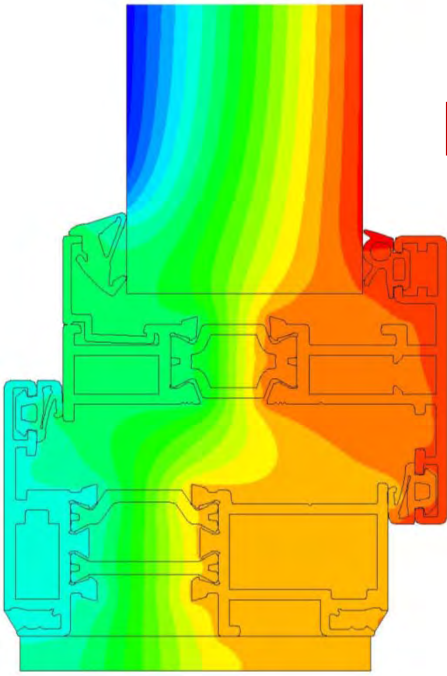


H- KITCHEN -GF				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-02	KITCHEN -GF	3490	540	1
TOTAL				1

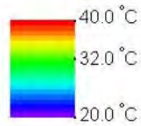
<u>4.6.1 Calculation of Thermal Transmittance of Section 01</u>

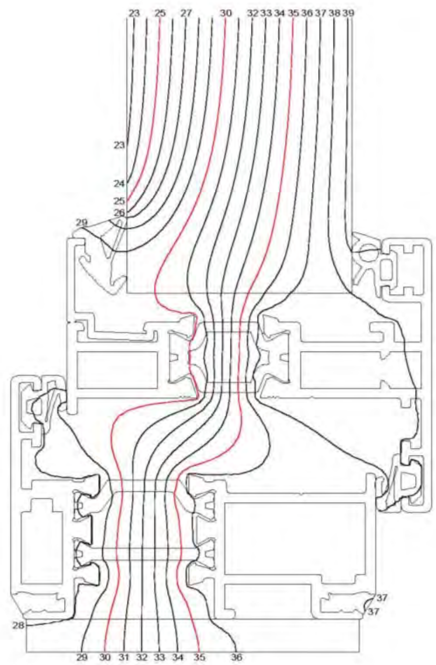
Thermal conductivity of materials





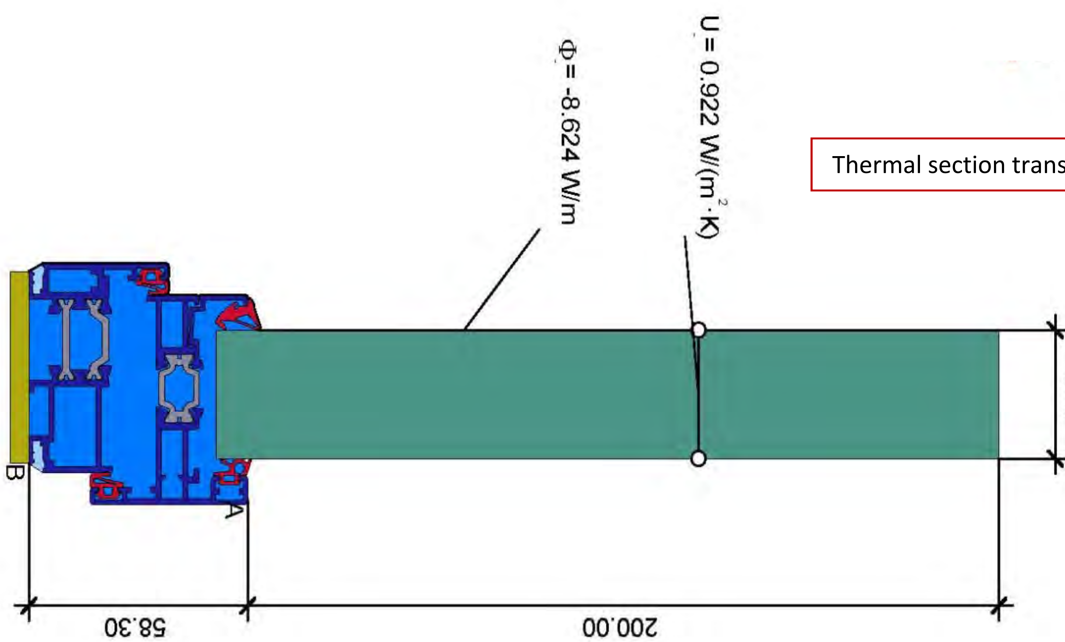
Isotherms - Temperature





Isotherms – Heat Transfer

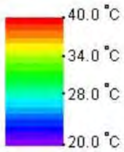
Thermal section transmittance

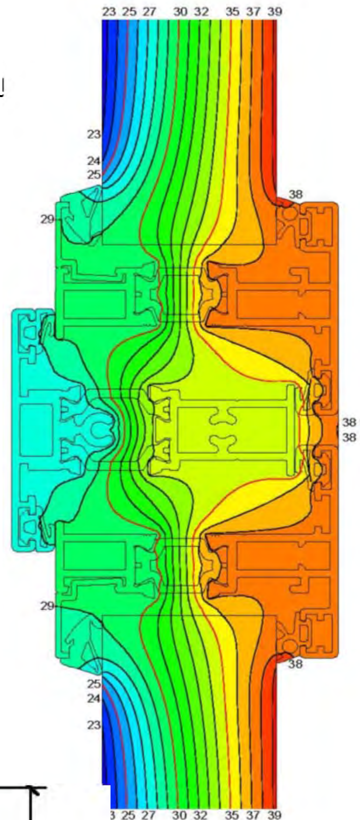


$$U_{f\,A,B} = \frac{\quad}{b_f} = \frac{[illegible]}{0.058} = \boxed{4.23\ W/(m^2 \cdot K)}$$

4.4.2 Calculation of Thermal Trans

Isotherms - Temperature

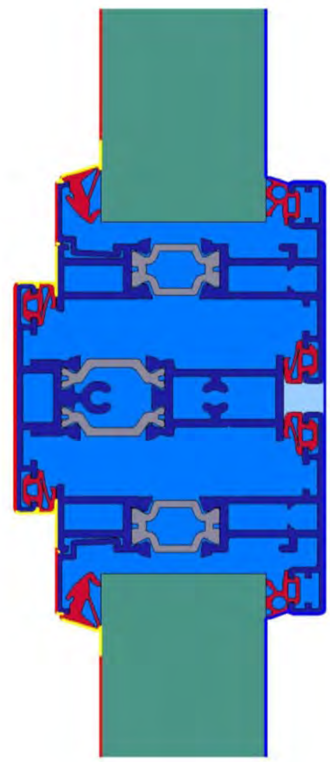


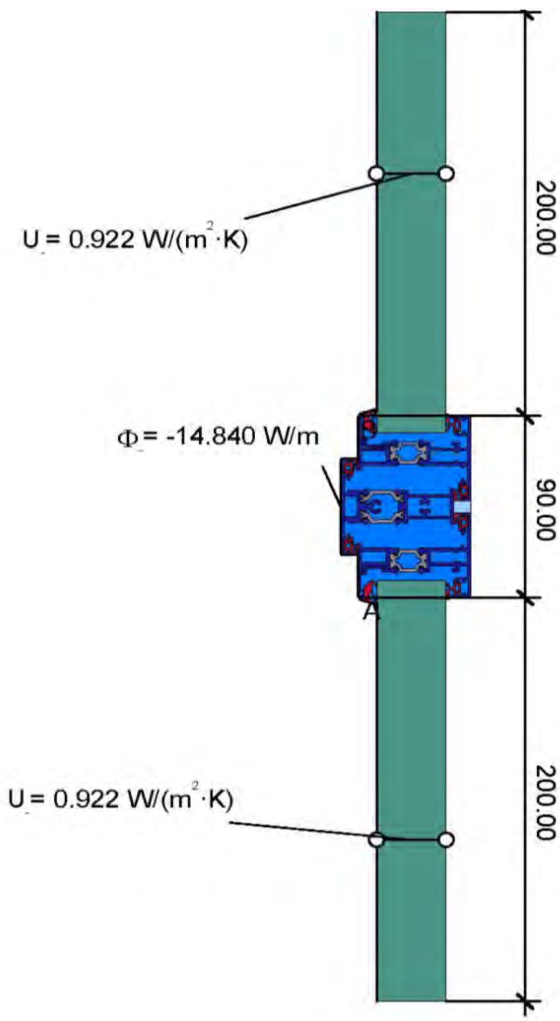


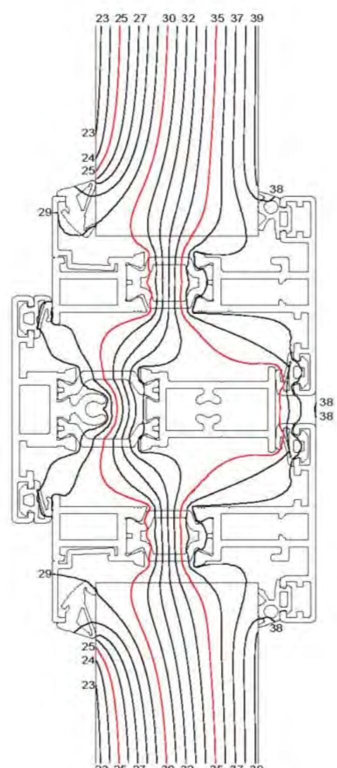
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity	anisotropic	
Unventilated air cavity	anisotropic	

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

Thermal conductivity of materials







Isotherms – Heat Transfer

Thermal section transmittance

$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\frac{14.840}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.090} = \boxed{4.15\ W/(m^2\cdot K)}$$

Thermal transmittance of combined window

F- KITCHEN -GF				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-02	KITCHEN -GF	3490	540	1
TOTAL				1

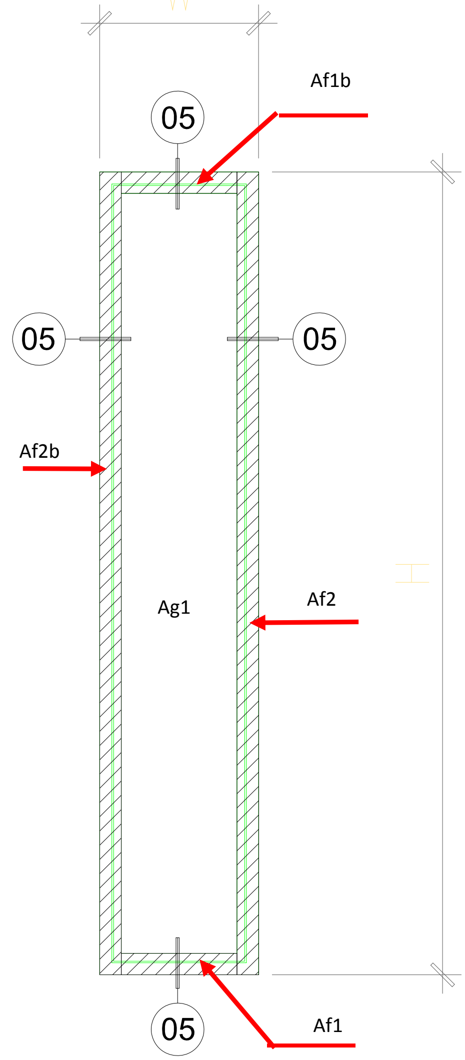
According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

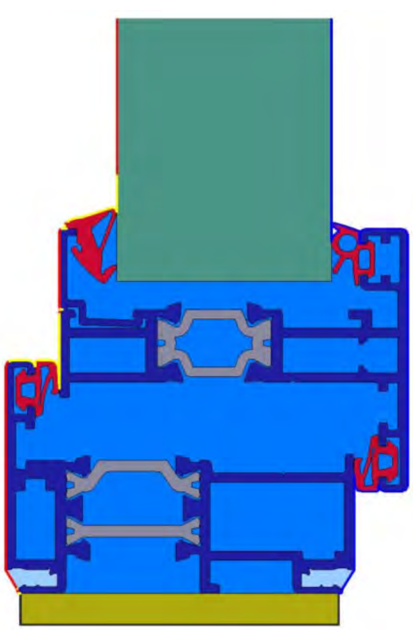
Dimension	Width	in[m]	3.490			Total window Area	in [m²]	1.885
	Height	in[m]	0.540					
Aluminium Frame					Glass Area			
Description		Unit	Value		Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.055		Glass area Ag1	Surface / unit	in [m²]	0.409
	Total Frame Area	in [m²]	0.030			Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230			Total Surface	in [m²]	0.464
Frame area Af1b	Exposed surface	in[m]	0.055		Glass area Ag2	Surface / unit	in [m²]	1.076
	Total Frame Area	in [m²]	0.030			Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230			Total Surface	in [m²]	0.956
Frame area Af2	Exposed surface	in[m]	0.055		Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	3.080
	Total Frame Area	in [m²]	0.186			Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.150			Toal Perimeter	in [m]	3.080
Frame area Af2b	Exposed surface	in[m]	0.055		Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.186			Quantity		0.000
	Thermal Transmittance	in [W/m²K]	4.150			Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.080		Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.034					
	Thermal Transmittance	in [W/m²K]	4.150				in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000		Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000					
	Thermal Transmittance	in [W/m²K]	0.000				in [W/mK]	0.050
Total Frame Area		in [m²]	0.466		Total Glass Area		in [m²]	1.419
S Af*Uf =	1.937	in [W/m²K]						
S Ag*Ug =	1.703	in [W/m²K]						
S Af*Uf =	0.154	in [W/m²K]			Thermal Transmittance of window (Uw)		in [W/m²K]	2.013

4.6 FIXED FRAME:



G - FIXED FRAME				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW-10	FAMILY LIVING	590	2990	3
TOTAL				3

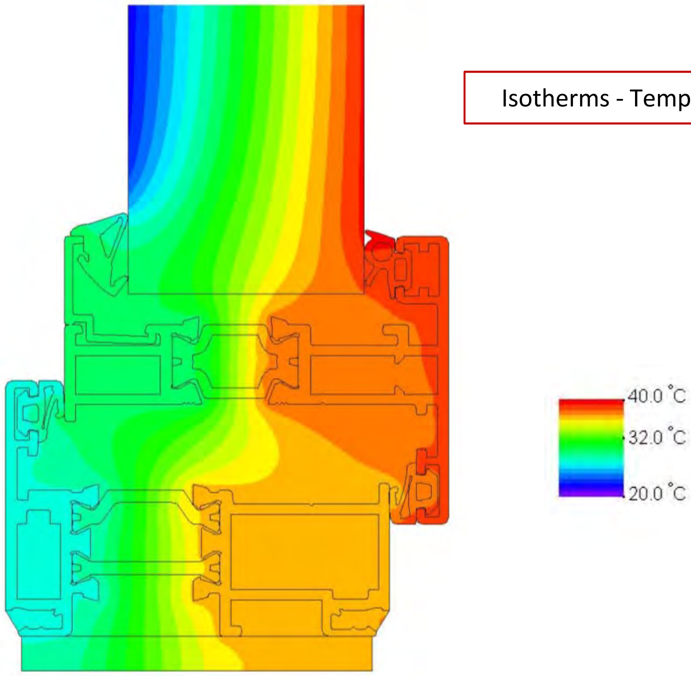
<u>4.6.1 Calculation of Thermal Transmittance of Section 01</u>



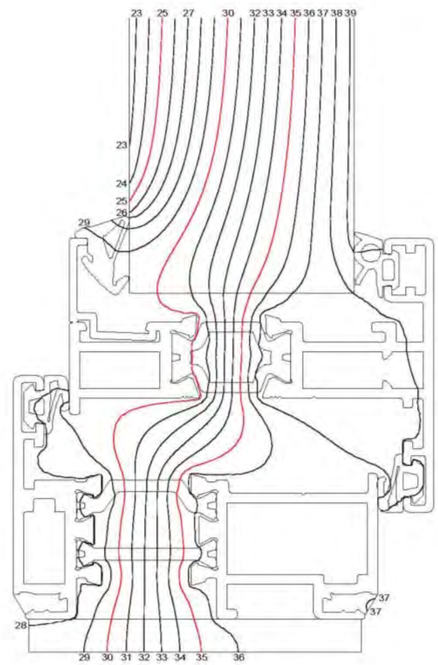
Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity	anisotropic	
Unventilated air cavity	anisotropic	

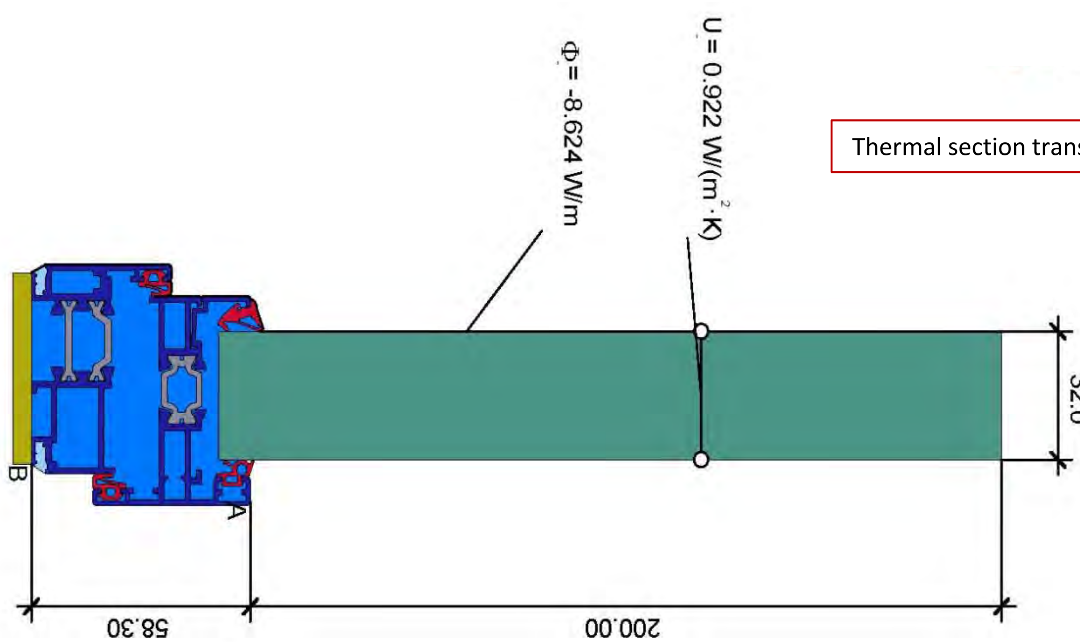
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



Isotherms - Temperature



Isotherms – Heat Transfer



Thermal section transmittance

$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.624}{20.000} - 0.922 \cdot 0.200}{0.058} = \boxed{4.23\ W/(m^2 \cdot K)}$$

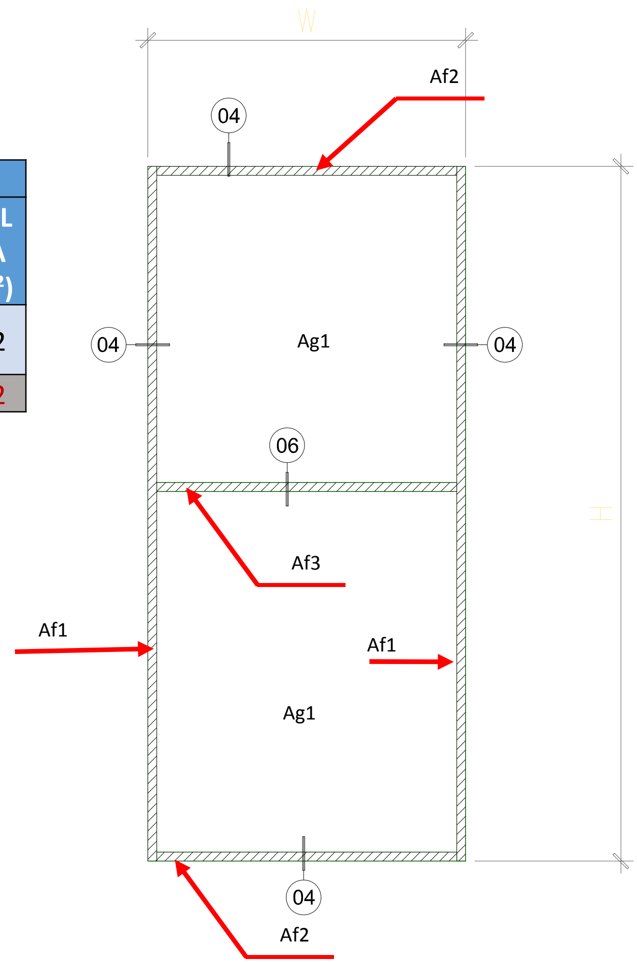
Thermal transmittance of Top Hung Windows With Fixed

I – FIXED FRAME				
REF.	**LOCATION**	**WIDTH (in mm)**	**HEIGHT (in mm)**	**QTY**
GW-10	FAMILY LIVING	590	2990	3

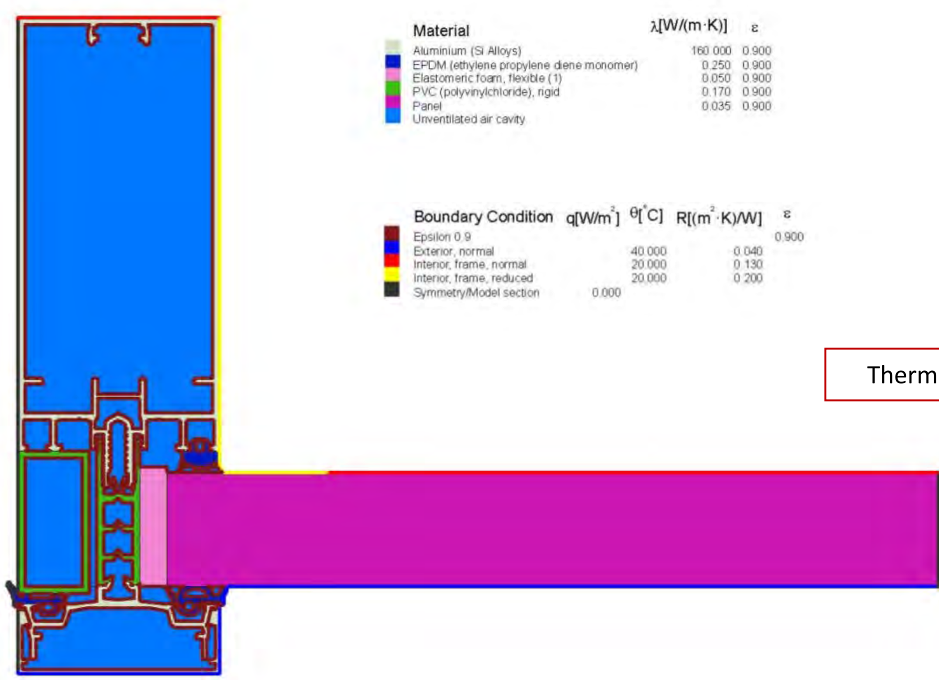
Dimension	Width	in[m]	0.590			Total window Area	in [m²]	1.764
	Height	in[m]	2.990					
Aluminium Frame					Glass Area			
Description		Unit	Value		Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.055		Glass area Ag1	Surface / unit	in [m²]	1.327
	Total Frame Area	in [m²]	0.164			Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.230			Total Surface	in [m²]	1.382
Frame area Af1b	Exposed surface	in[m]	0.055		Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.164			Quantity		0.000
	Thermal Transmittance	in [W/m²K]	4.230			Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.055		Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	3.080
	Total Frame Area	in [m²]	0.026			Quantity		1.000
	Thermal Transmittance	in [W/m²K]	4.150			Toal Perimeter	in [m]	3.080
Frame area Af2b	Exposed surface	in[m]	0.055		Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.026			Quantity		0.000
	Thermal Transmittance	in [W/m²K]	4.150			Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.000		Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.000					
	Thermal Transmittance	in [W/m²K]	0.000				in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000		Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000					
	Thermal Transmittance	in [W/m²K]	0.000				in [W/mK]	0.050
Total Frame Area		in [m²]	0.382		Total Glass Area		in [m²]	1.382
S Af*Uf =	1.610	in [W/m²K]						
S Ag*Ug =	1.659	in [W/m²K]						
S Af*Uf =	0.154	in [W/m²K]			**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.941**

4.7 CURTAIN WALL – 2 FIXED FIELD

G- CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-23	Near staircase 01	1780	3900	6.942	1	6.942
TOTAL					1	6.942



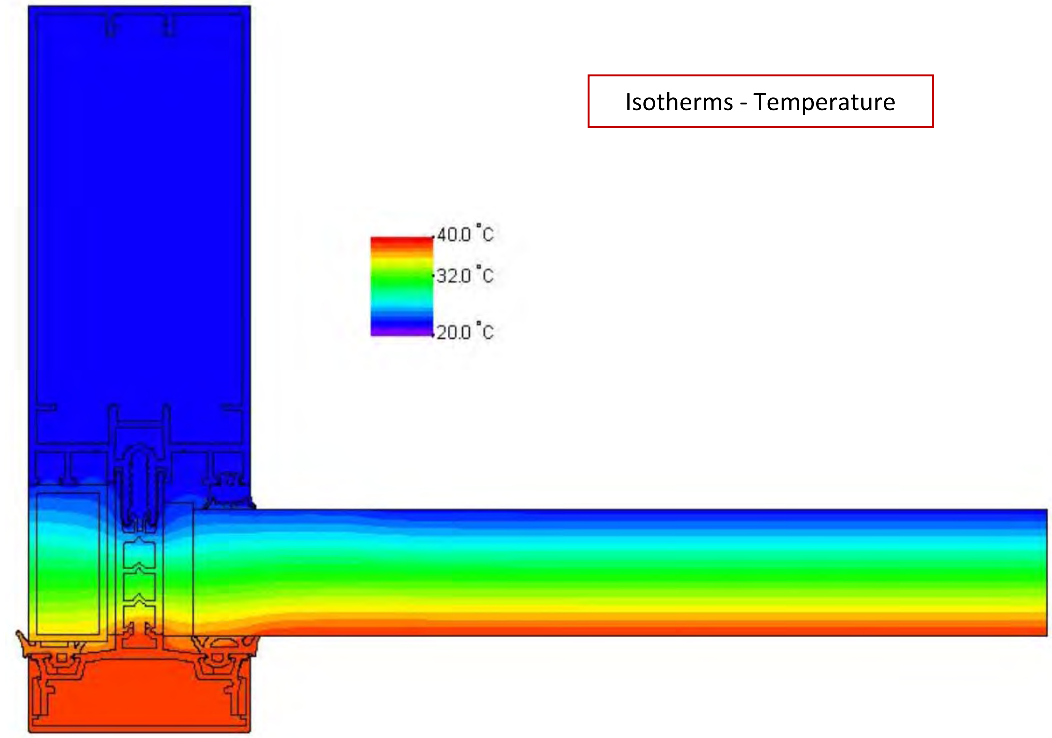
4.7.1 Calculation of Thermal Transmittance of Section 07



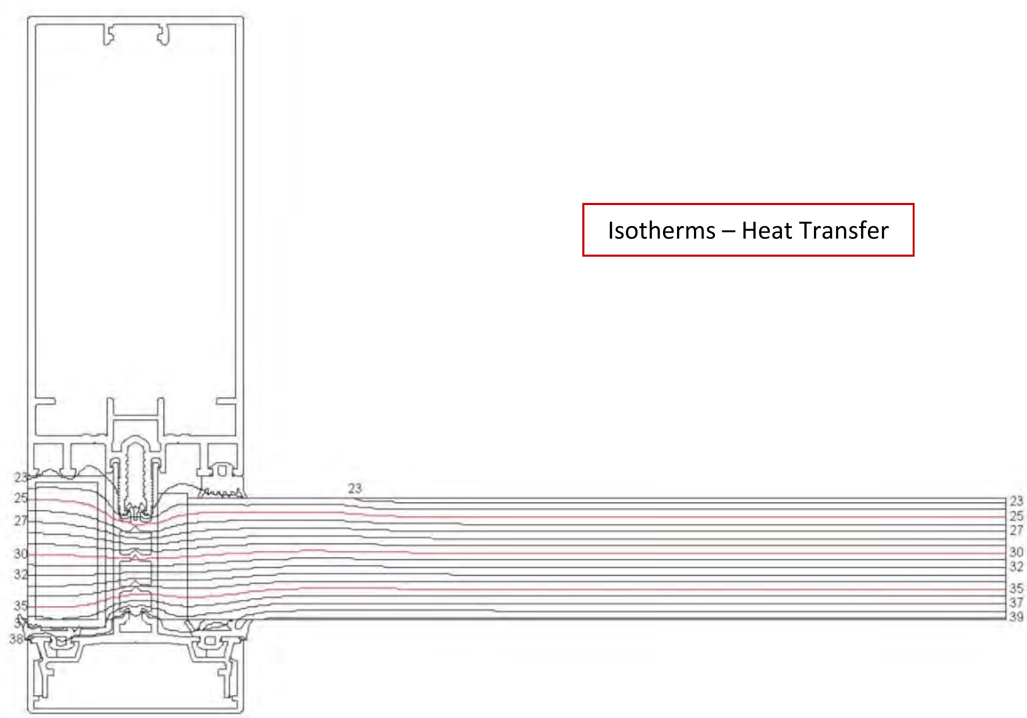
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

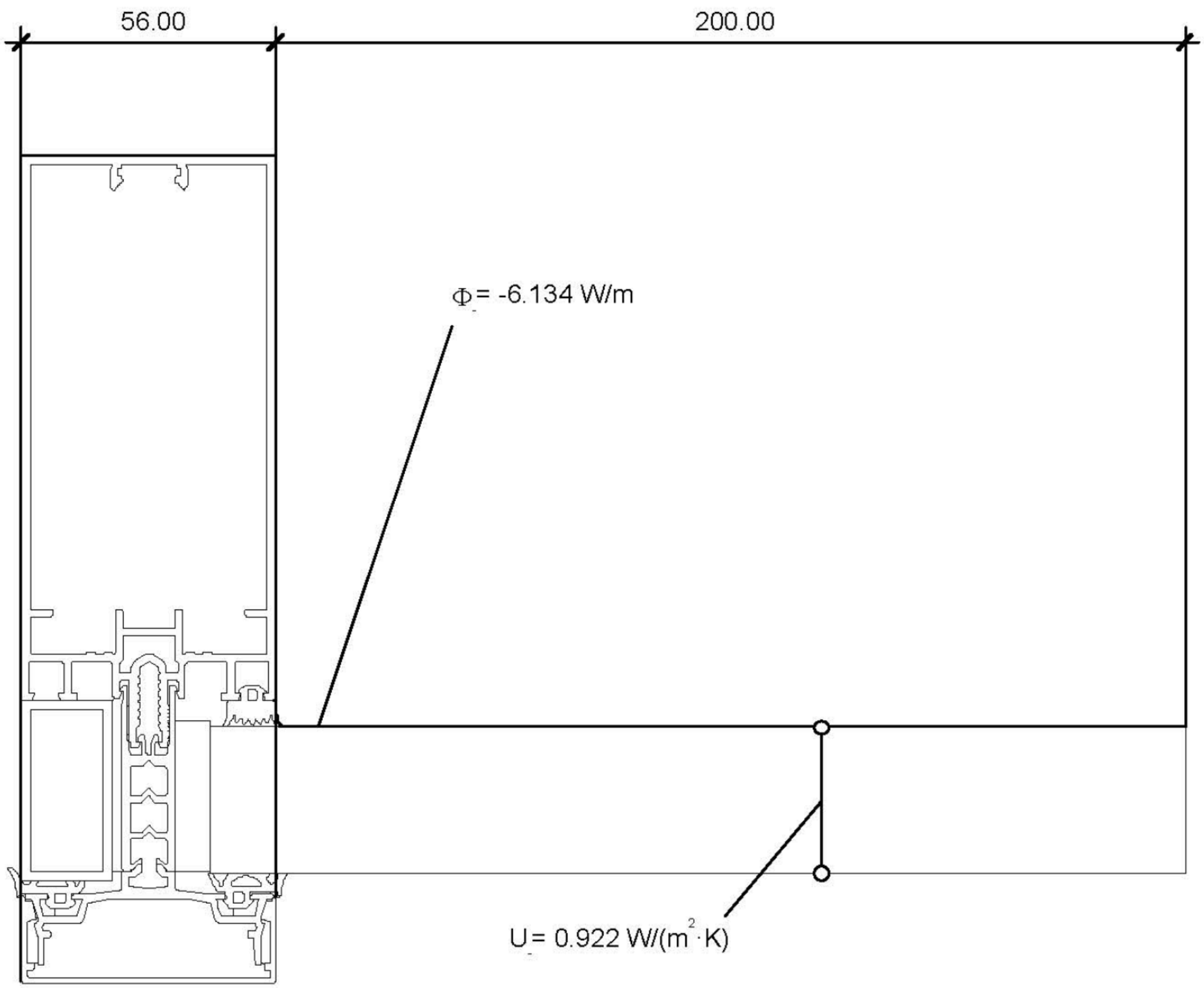
Thermal conductivity of materials



Isotherms - Temperature



Isotherms – Heat Transfer

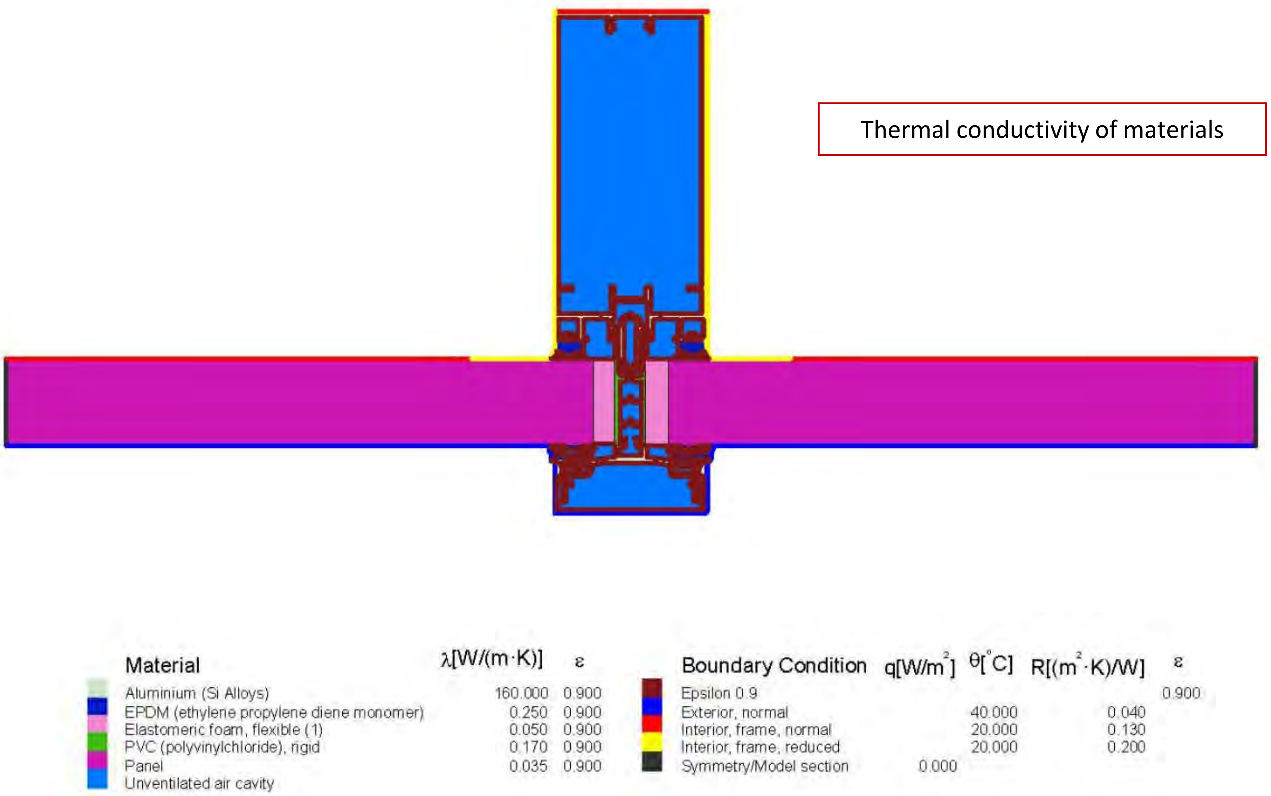


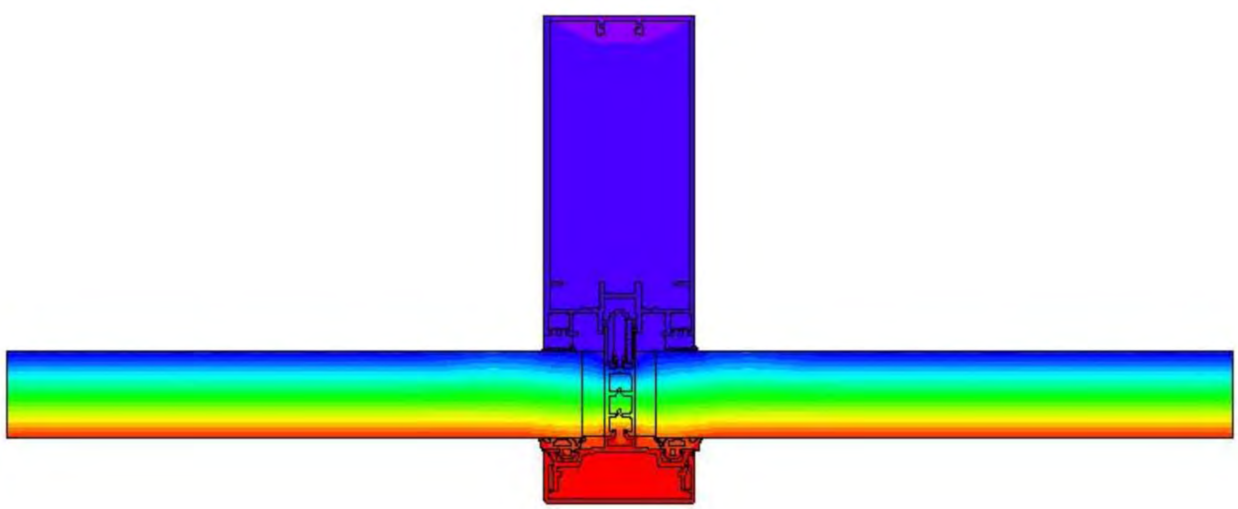
Thermal section transmittance

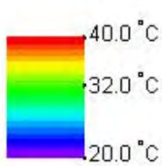
$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

4.8.2 Calculation of Thermal Transmittance of Section 08

Thermal conductivity of materials

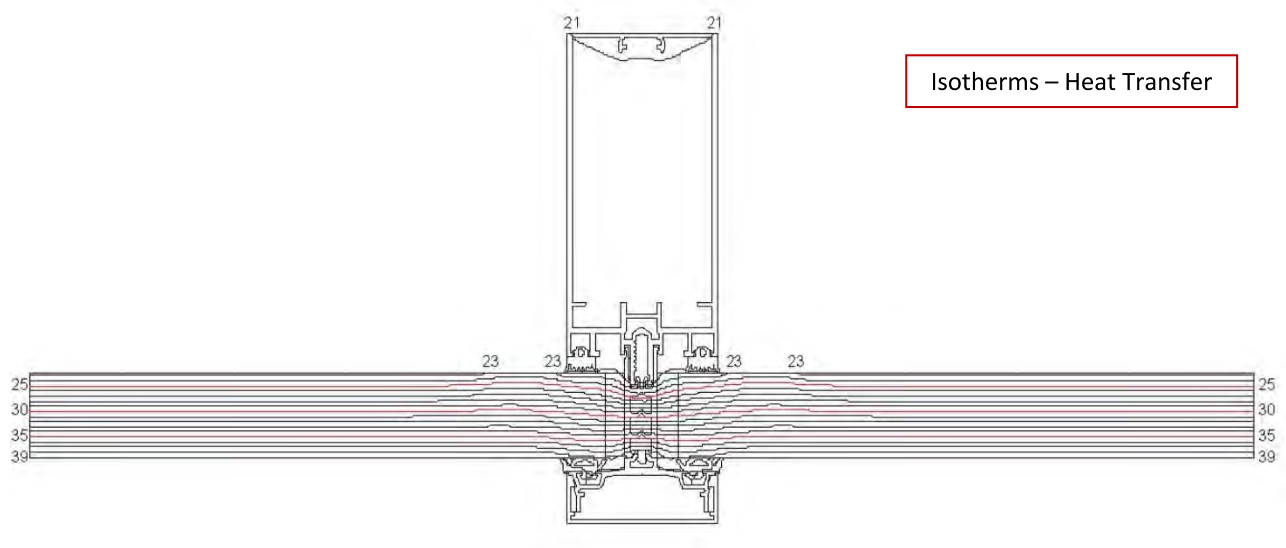




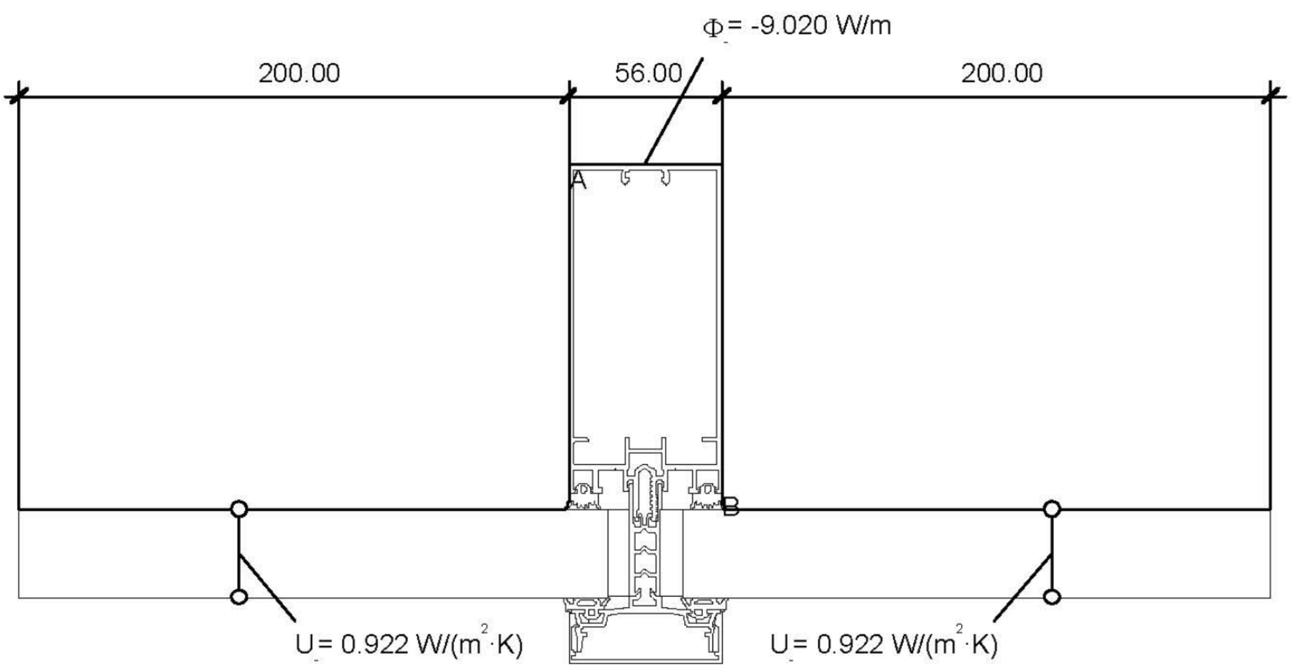


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2\cdot K)}$$

Thermal transmittance of curtain wall

F CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-23	STAIR CASE 01	1780	3900	6.942	1	6.942
TOTAL					1	5.942

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

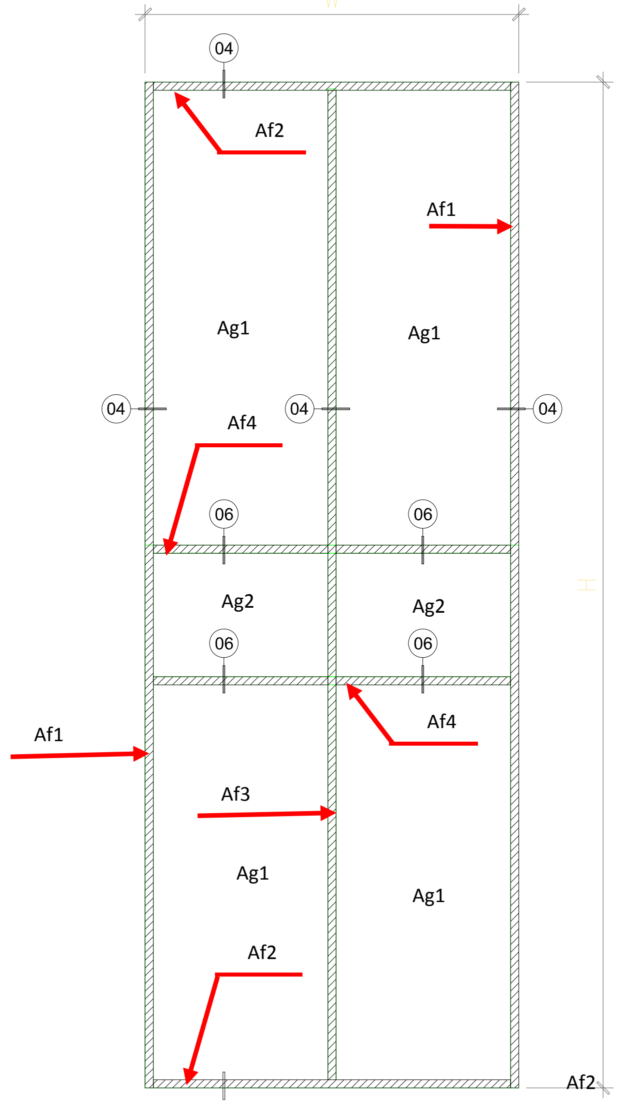
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

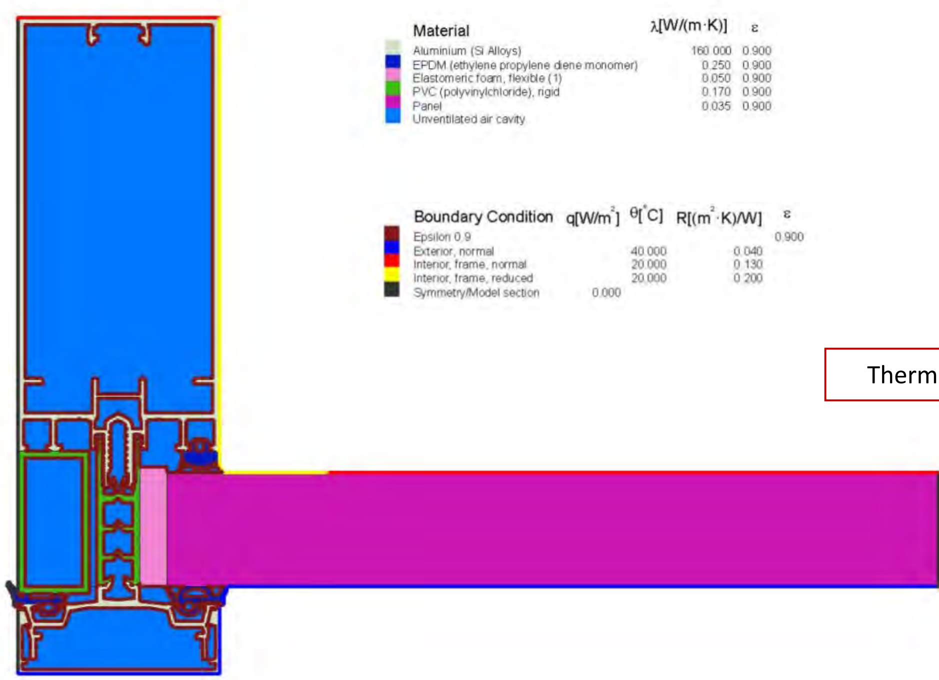
Dimension	Width	in[m]	1.780		Total window Area	in [m²]	6.942
	Height	in[m]	3.900				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	6.106
	Total Frame Area	in [m²]	0.437		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	6.106
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	15.776
	Total Frame Area	in [m²]	0.187		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	15.776
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.056	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.212				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.836	Total Glass Area		in [m²]	6.106
S Af*Uf =	1.671	in [W/m²K]					
S Ag*Ug =	7.327	in [W/m²K]					
S Af*Uf =	0.7888	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.410**

4.8 CURTAIN WALL

F - CURTAIN WALL				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-01	STAIRCASE	2550	6880	1
TOTAL				1



4.8.1 Calculation of Thermal Transmittance of Section 07

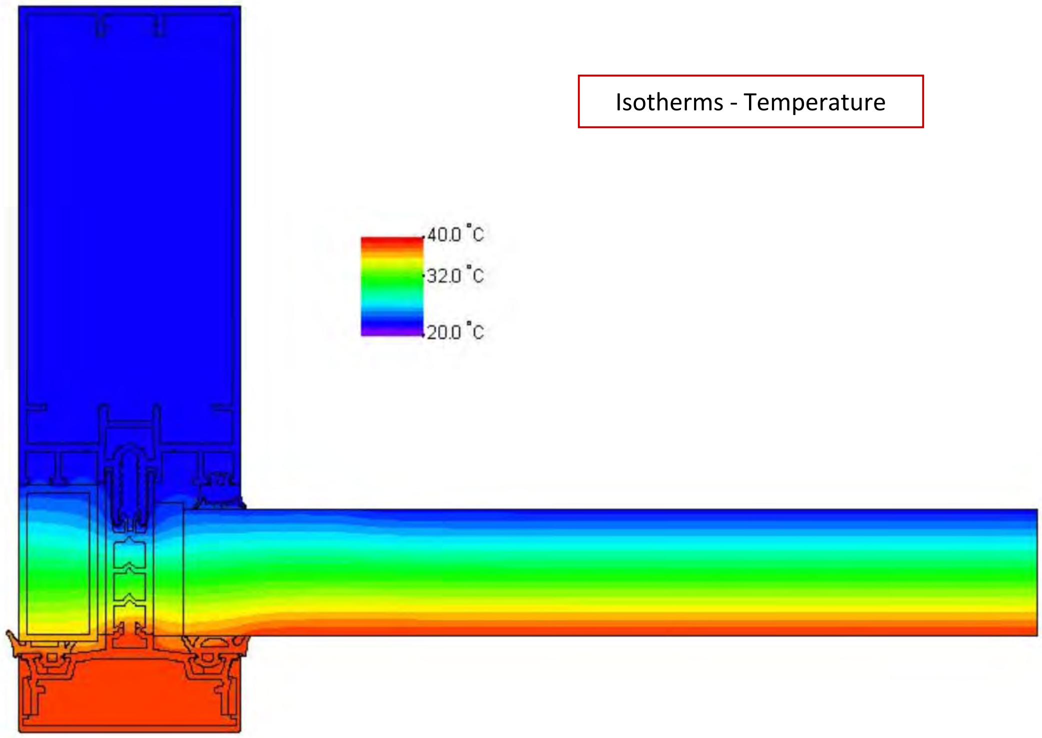


Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

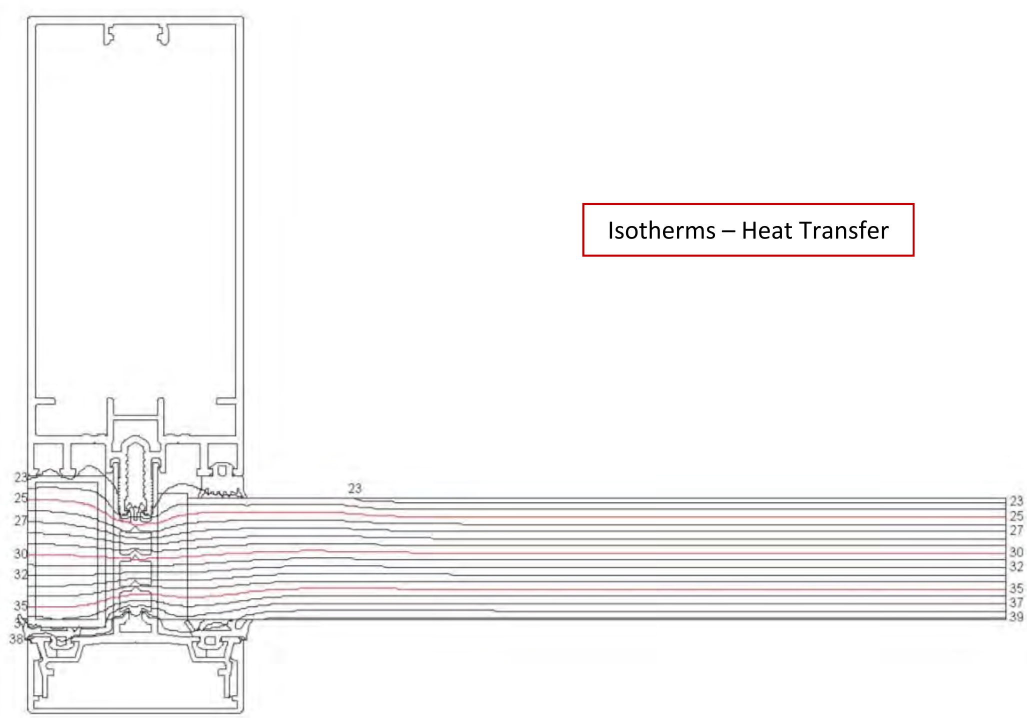
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

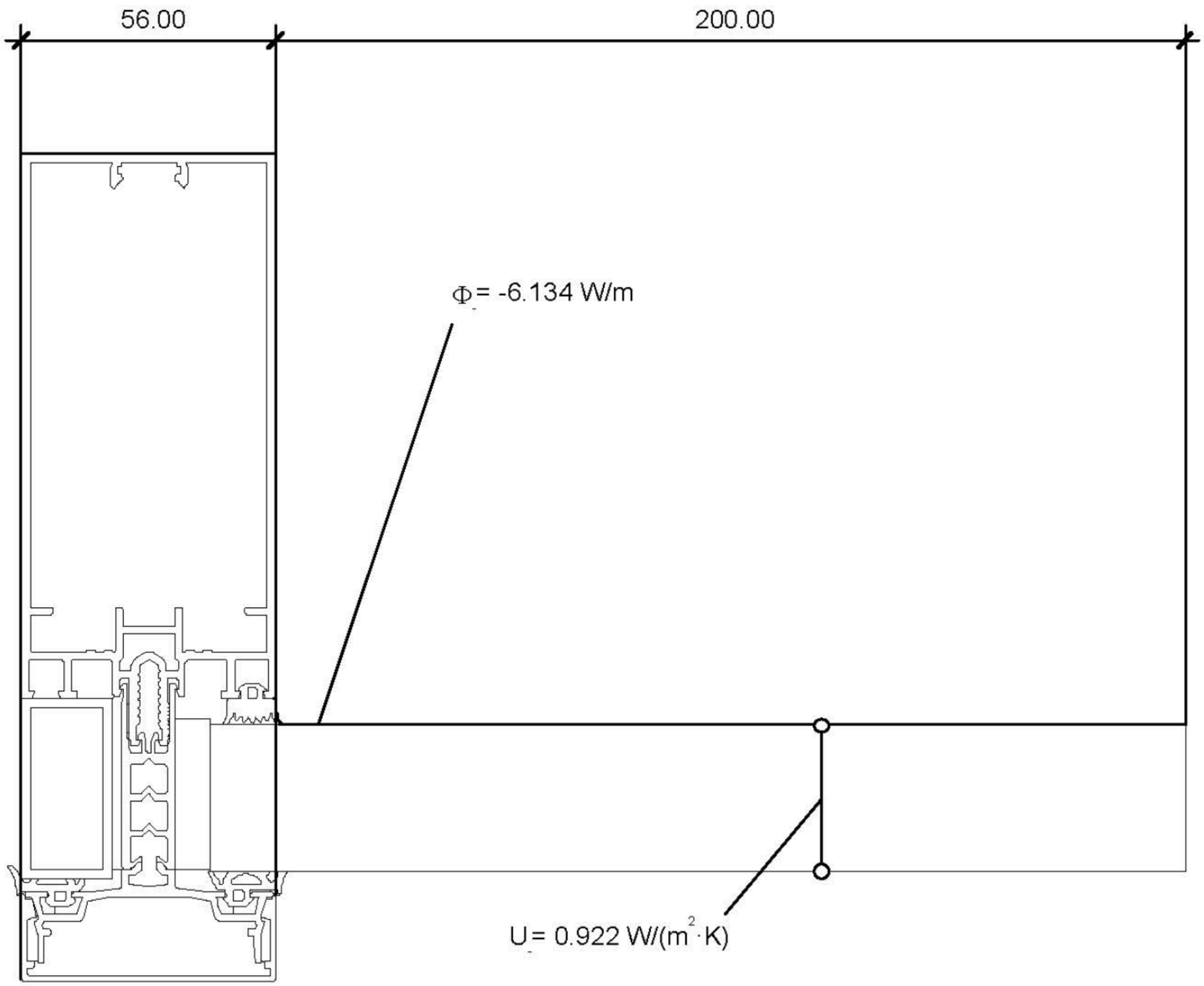
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer

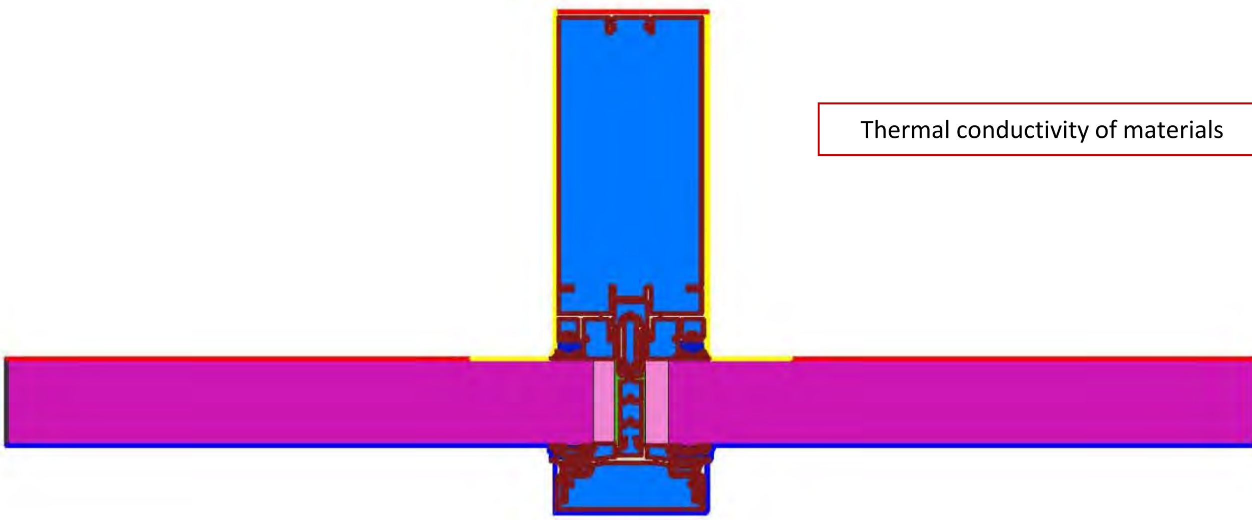




Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

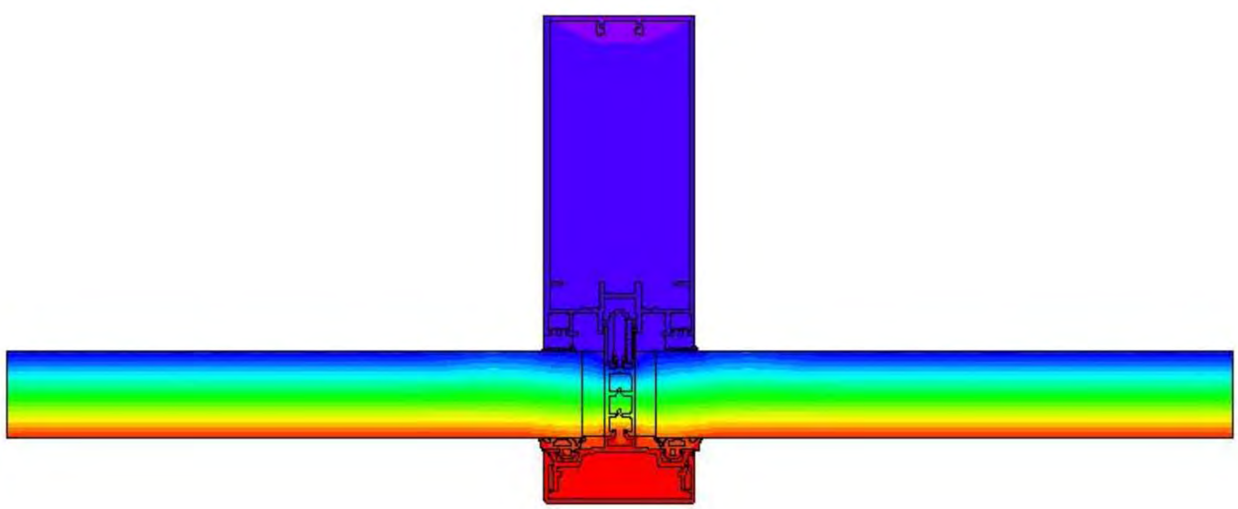
4.8.2 Calculation of Thermal Transmittance of Section 08



Thermal conductivity of materials

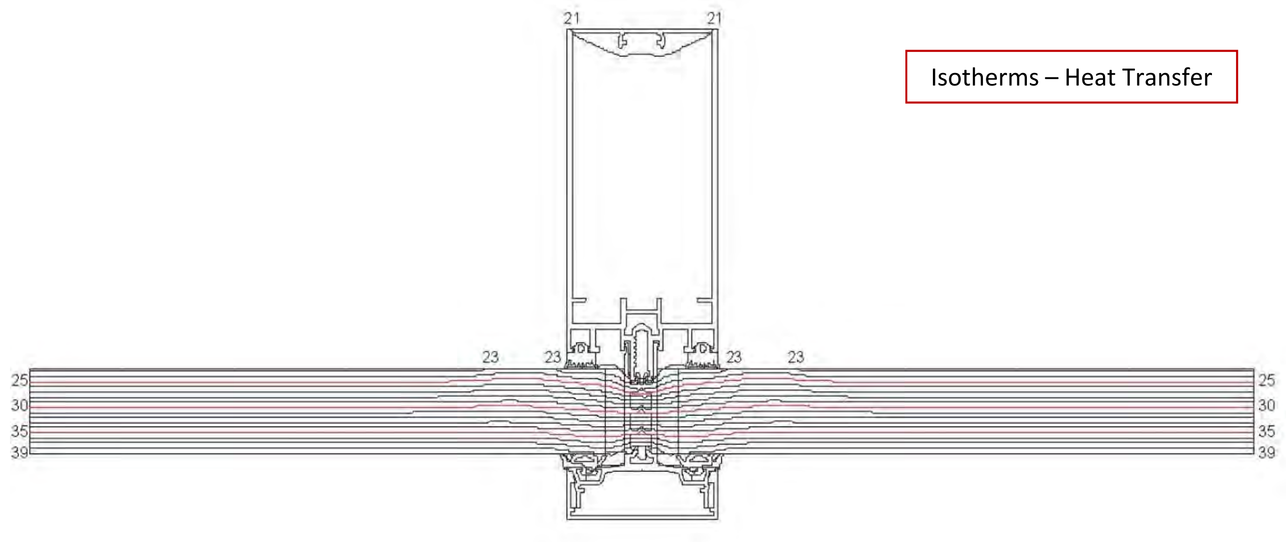
	Material	λ[W/(m·K)]	ε
	Aluminium (Si Alloys)	160.000	0.900
	EPDM (ethylene propylene diene monomer)	0.250	0.900
	Elastomeric foam, flexible (1)	0.050	0.900
	PVC (polyvinylchloride), rigid	0.170	0.900
	Panel	0.035	0.900
	Unventilated air cavity		

	Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
	Epsilon 0.9				0.900
	Exterior, normal		40.000	0.040	
	Interior, frame, normal		20.000	0.130	
	Interior, frame, reduced		20.000	0.200	
	Symmetry/Model section	0.000			

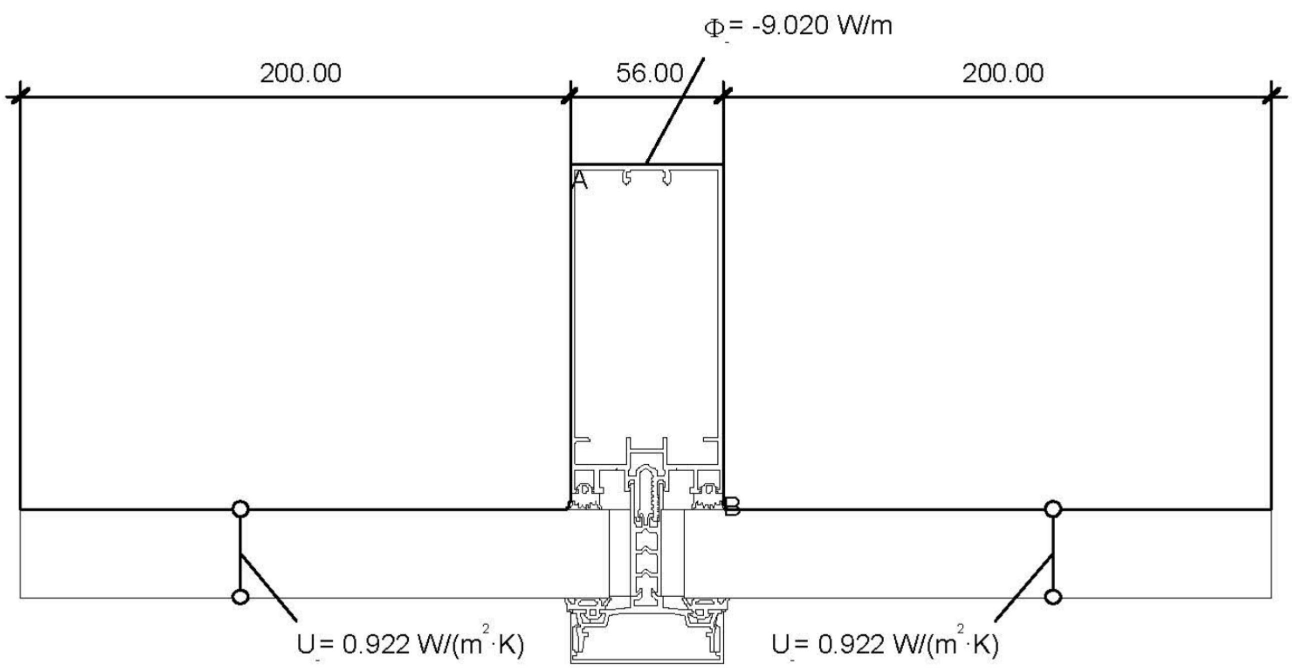


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2 \cdot K)}$$

Thermal transmittance of curtain wall

I- CURTAIN WALL WITH 4 FIXED FIELD				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-01	STAIRCASE	2550	6880	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

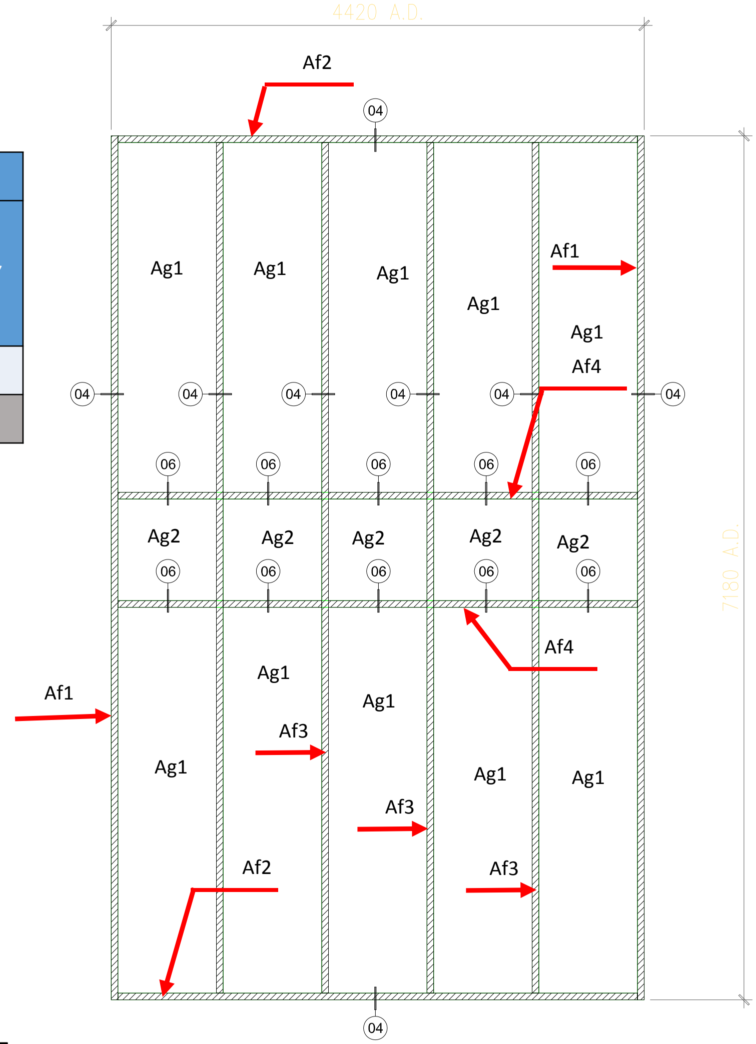
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

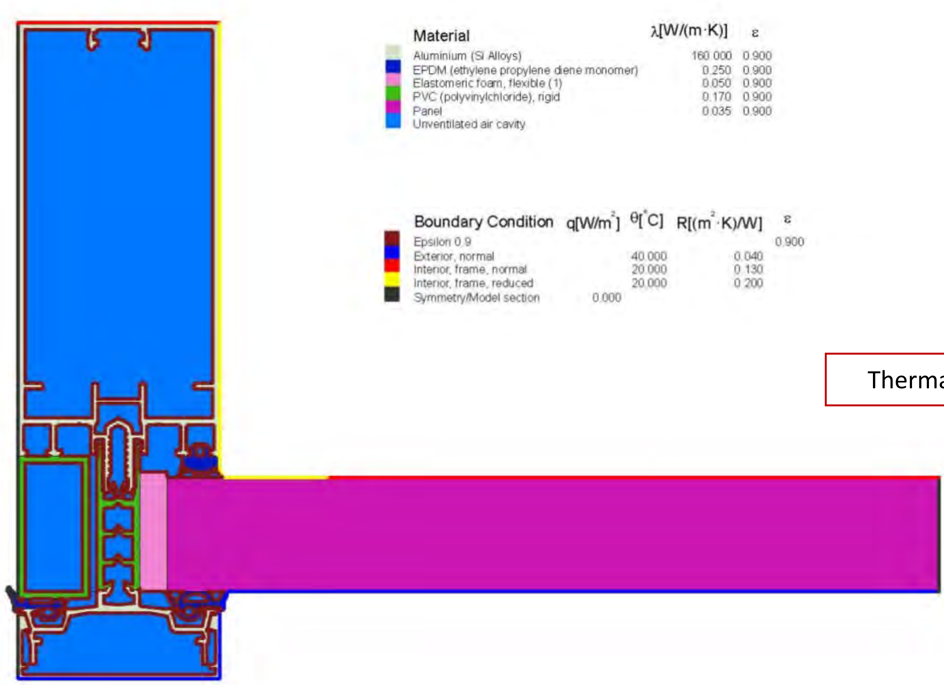
Dimension	Width	in[m]	2.550			Total window Area	in [m²]	17.544
	Height	in[m]	6.880					
Aluminium Frame					Glass Area			
	Description	Unit	Value			Description	Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056		Glass area Ag1	Surface / unit	in [m²]	3.403
	Total Frame Area	in [m²]	0.771			Quantity		4.000
	Thermal Transmittance	in [W/m²K]	2.180			Total Surface	in [m²]	13.665
Frame area Af1b	Exposed surface	in[m]	0.000		Glass area Ag2	Surface / unit	in [m²]	1.005
	Total Frame Area	in [m²]	0.000			Quantity		2.000
	Thermal Transmittance	in [W/m²K]	0.000			Total Surface	in [m²]	2.010
Frame area Af2	Exposed surface	in[m]	0.056		Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	8.180
	Total Frame Area	in [m²]	0.273			Quantity		4.000
	Thermal Transmittance	in [W/m²K]	2.180			Toal Perimeter	in [m]	32.720
Frame area Af2b	Exposed surface	in[m]	0.000		Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	4.080
	Total Frame Area	in [m²]	0.000			Quantity		2.000
	Thermal Transmittance	in [W/m²K]	0.000			Toal Perimeter	in [m]	8.160
Frame area Af3	Exposed surface	in[m]	0.056		Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.758					
	Thermal Transmittance	in [W/m²K]	1.470				in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.056		Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.267					
	Thermal Transmittance	in [W/m²K]	1.470				in [W/mK]	0.050
Total Frame Area		in [m²]	2.068		Total Glass Area		in [m²]	15.676
S Af*Uf =	3.389	in [W/m²K]						
S Ag*Ug =	18.811	in [W/m²K]						
S Af*Uf =	2.044	in [W/m²K]			Thermal Transmittance of window (Uw)		in [W/m²K]	1.366

4.8 CURTAIN WALL

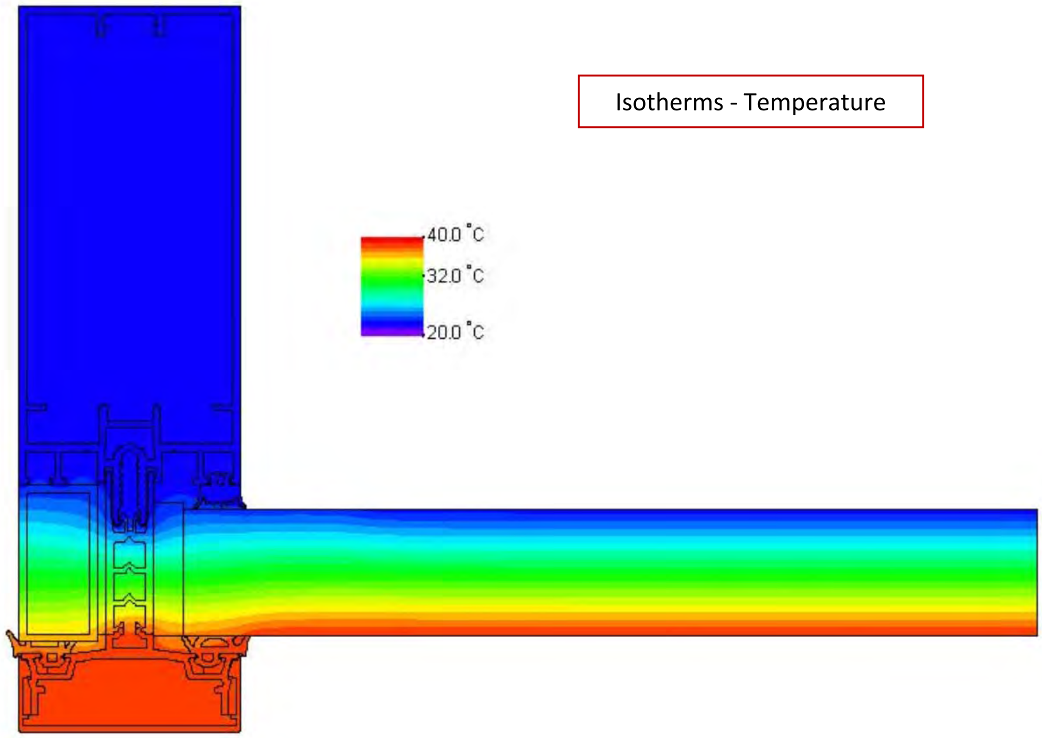
F - CURTAIN WALL				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-22	Family living	4420	7180	1
TOTAL				1



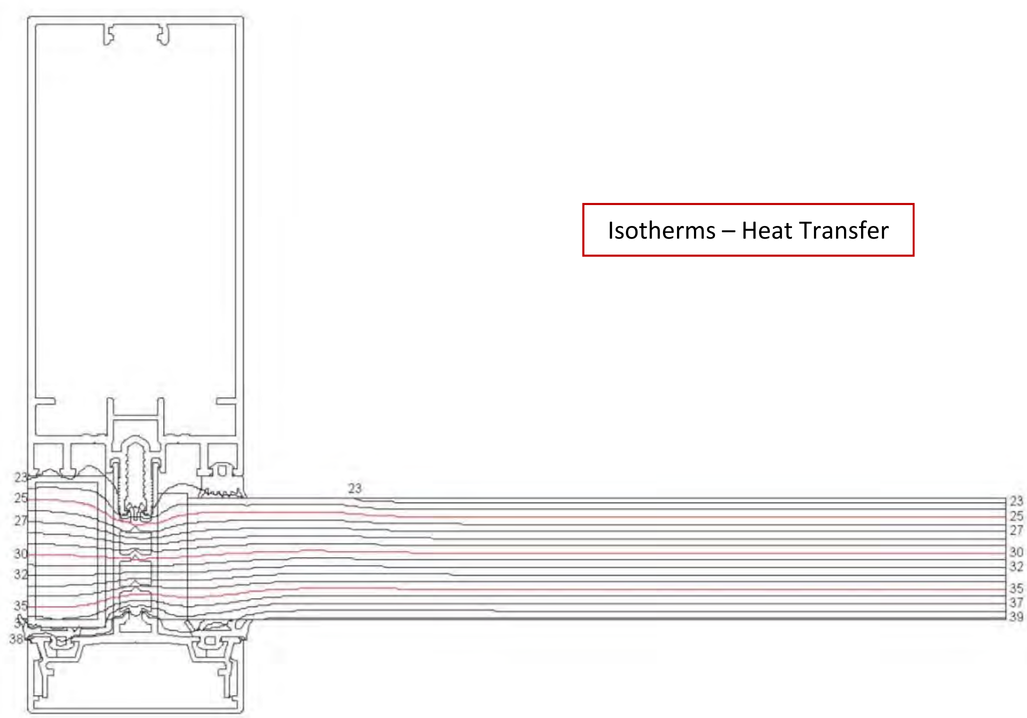
4.8.1 Calculation of Thermal Transmittance of Section 07



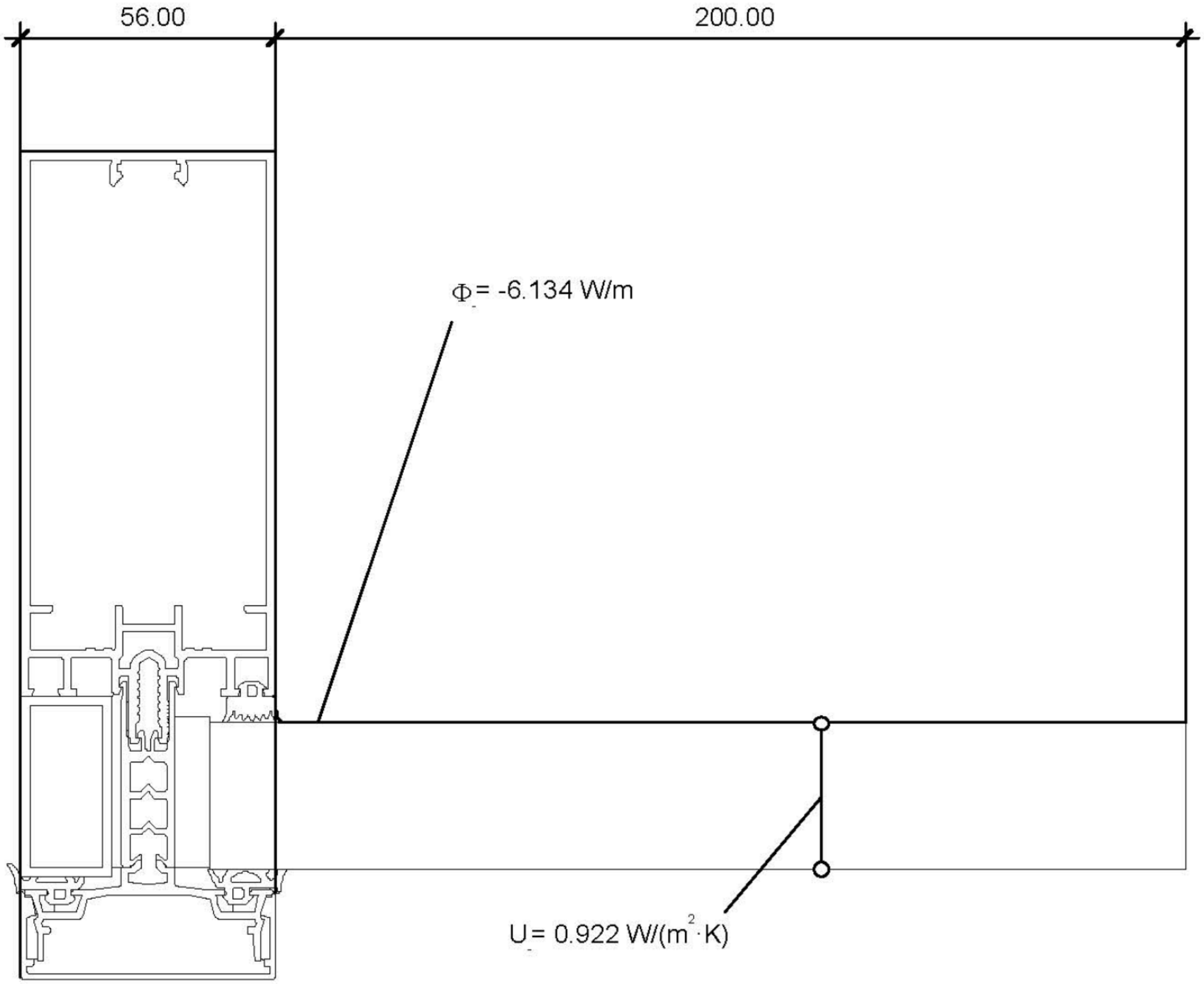
Thermal conductivity of materials



Isotherms - Temperature



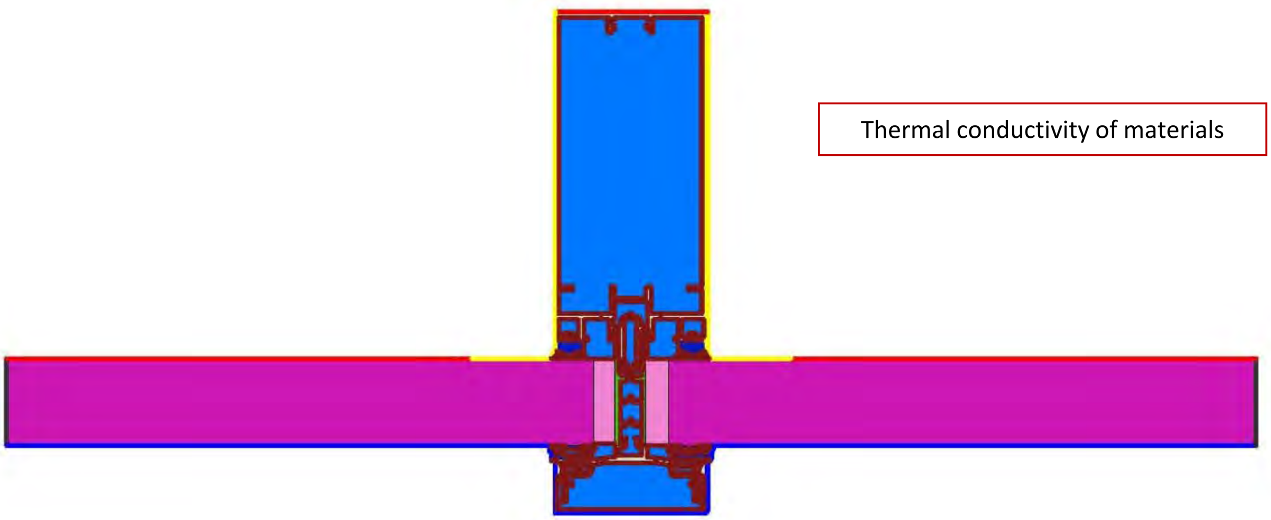
Isotherms – Heat Transfer



Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

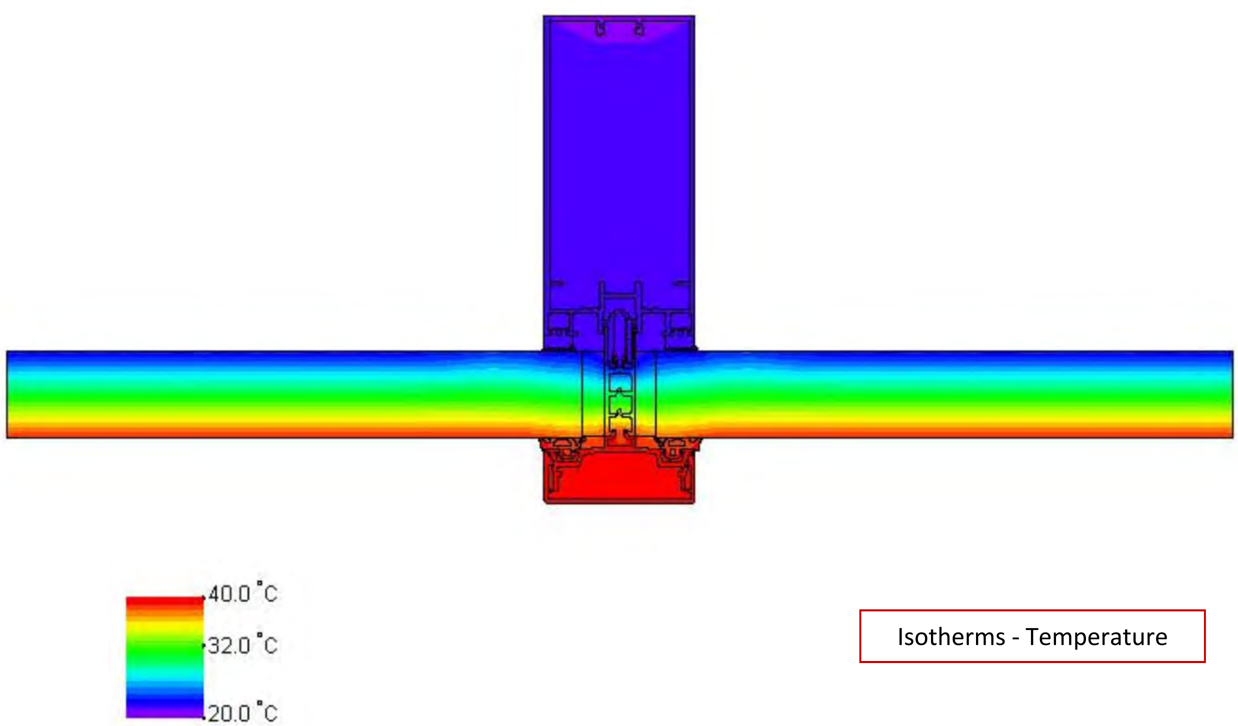
4.8.2 Calculation of Thermal Transmittance of Section 08



Thermal conductivity of materials

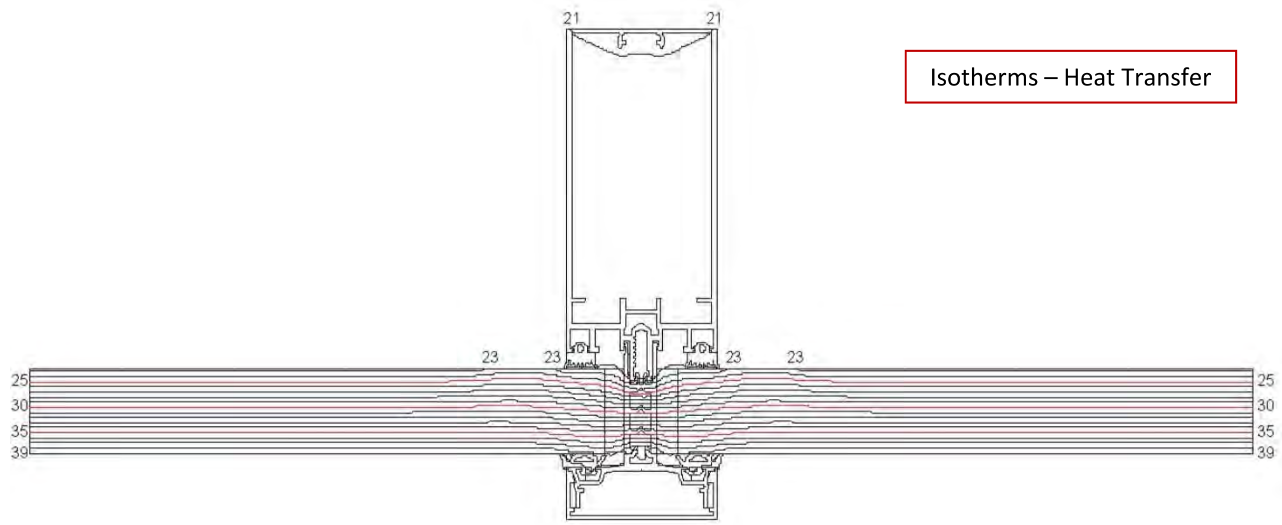
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

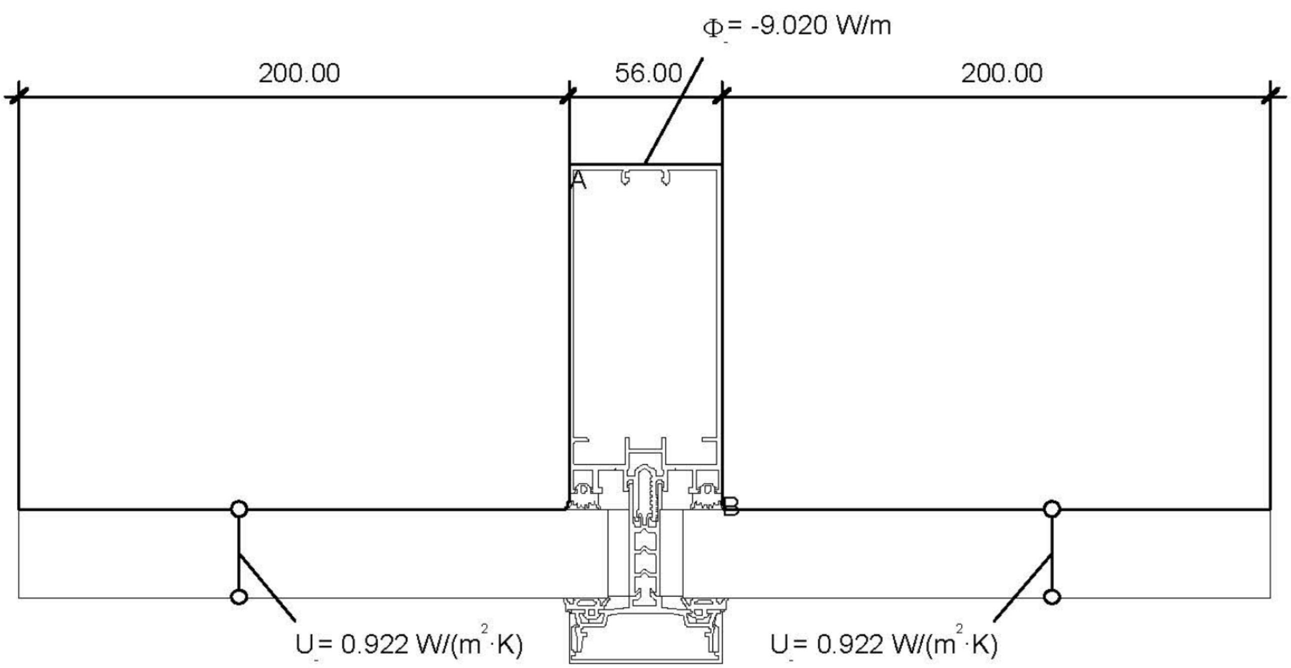


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\dfrac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\dfrac{9.020}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2\cdot K)}$$

Thermal transmittance of curtain wall

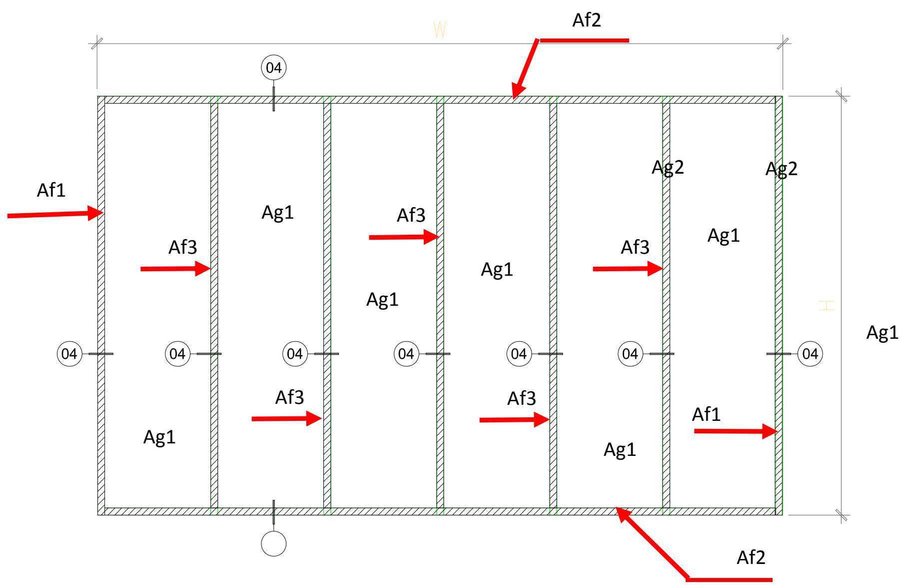
I- CURTAIN WALL WITH 4 FIXED FIELD				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-22	FAMILY LIVING	4420	7180	1
TOTAL				1

Dimension	Width	in[m]	4.420		Total window Area	in [m²]	31.736
	Height	in[m]	7.180				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	2.491
	Total Frame Area	in [m²]	0.804		Quantity		10.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	24.968
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.690
	Total Frame Area	in [m²]	0.000		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	3.448
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.680
	Total Frame Area	in [m²]	0.482		Quantity		10.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	76.800
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	3.340
	Total Frame Area	in [m²]	0.000		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	16.700
Frame area Af3	Exposed surface	in[m]	0.056	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	1.583				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.056	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.451				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/mK]	0.050
Total Frame Area		in [m²]	3.321	Total Glass Area		in [m²]	28.415
S Af*Uf =	5.132	in [W/m²K]					
S Ag*Ug =	34.098	in [W/m²K]					
S Af*Uf =	4.675	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.383**

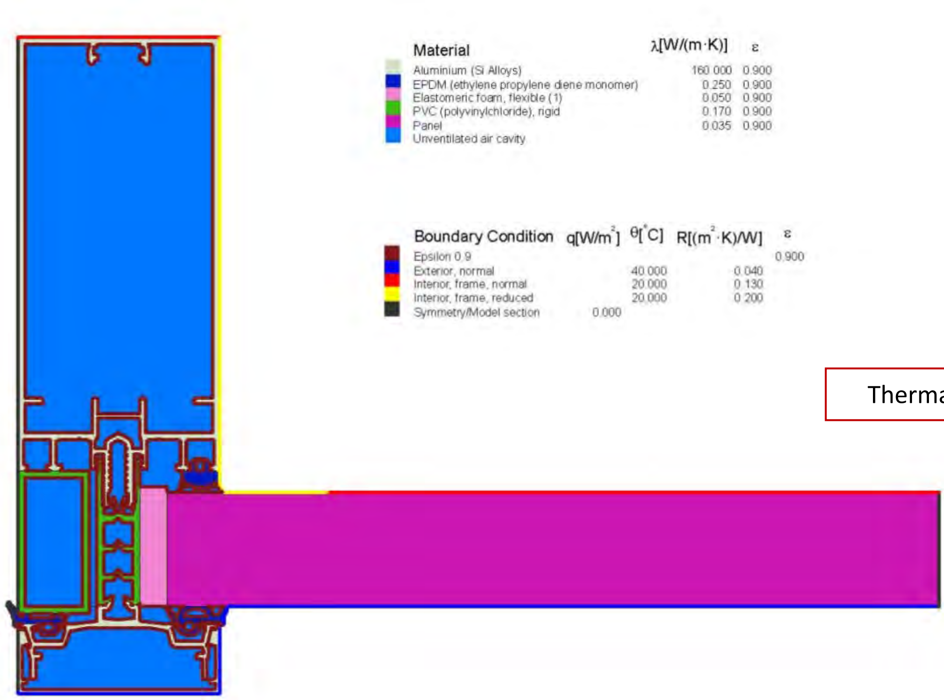
S

4.8 CURTAIN WALL

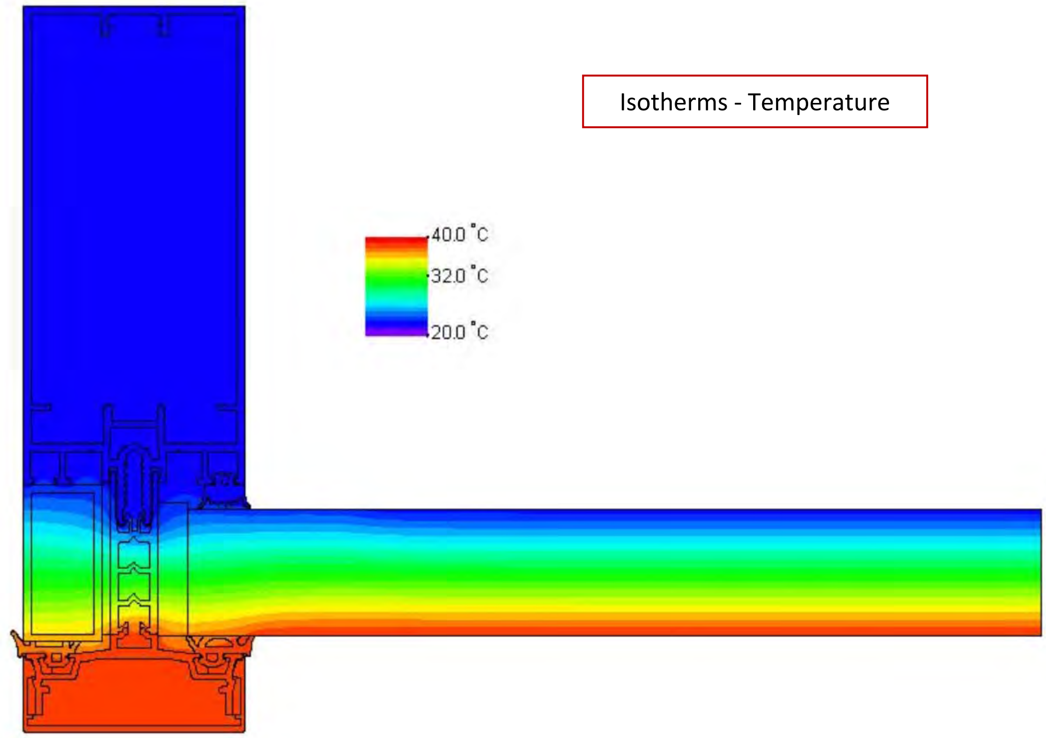
F - CURTAIN WALL				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW04	MAJLIS	5385	3280	1
TOTAL				1



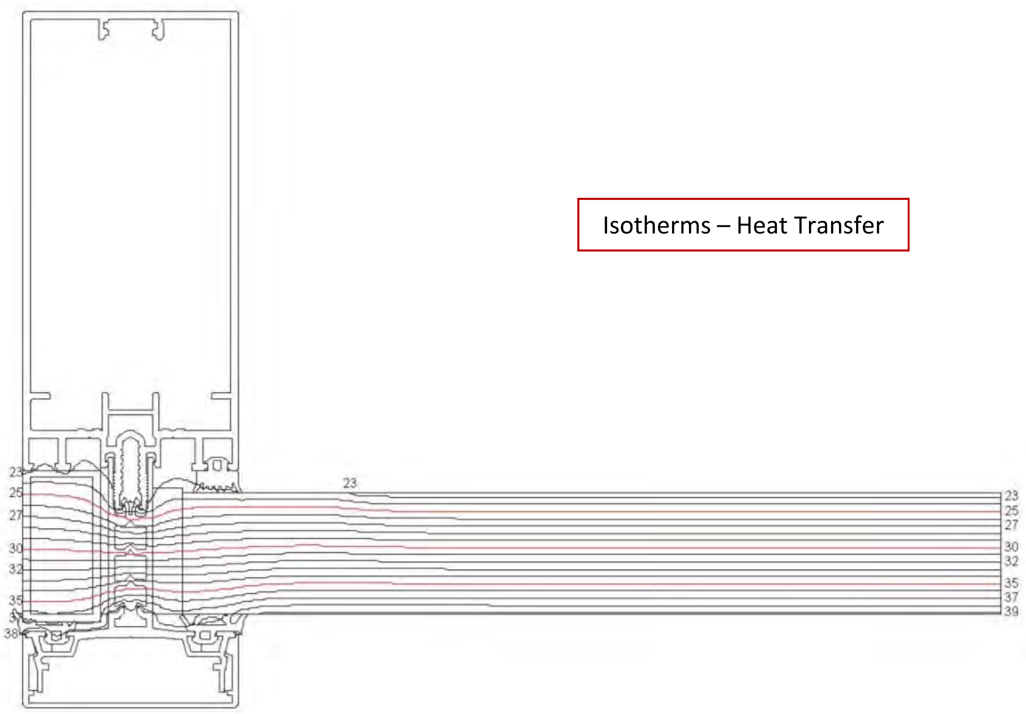
4.8.1 Calculation of Thermal Transmittance of Section 07



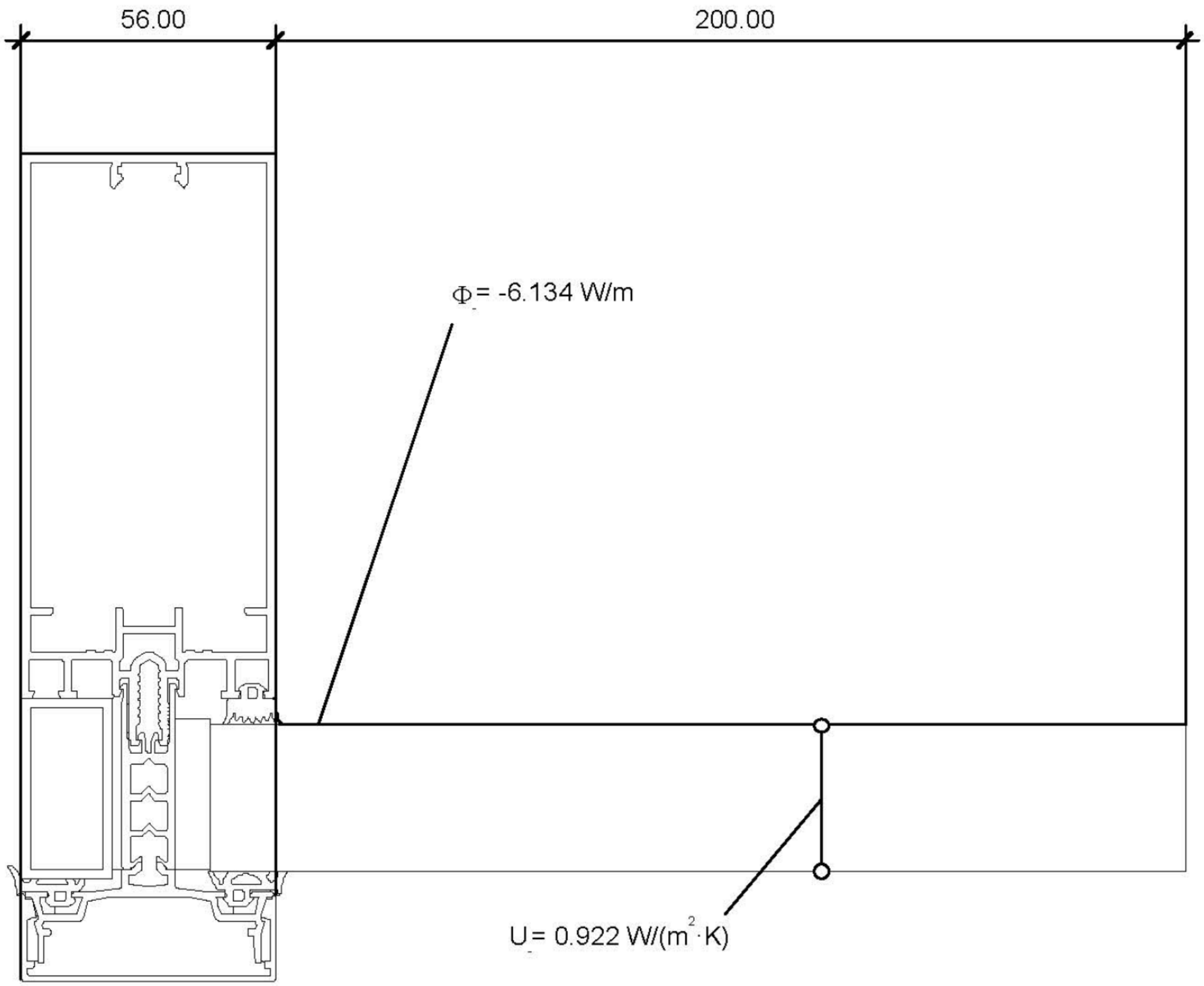
Thermal conductivity of materials



Isotherms - Temperature



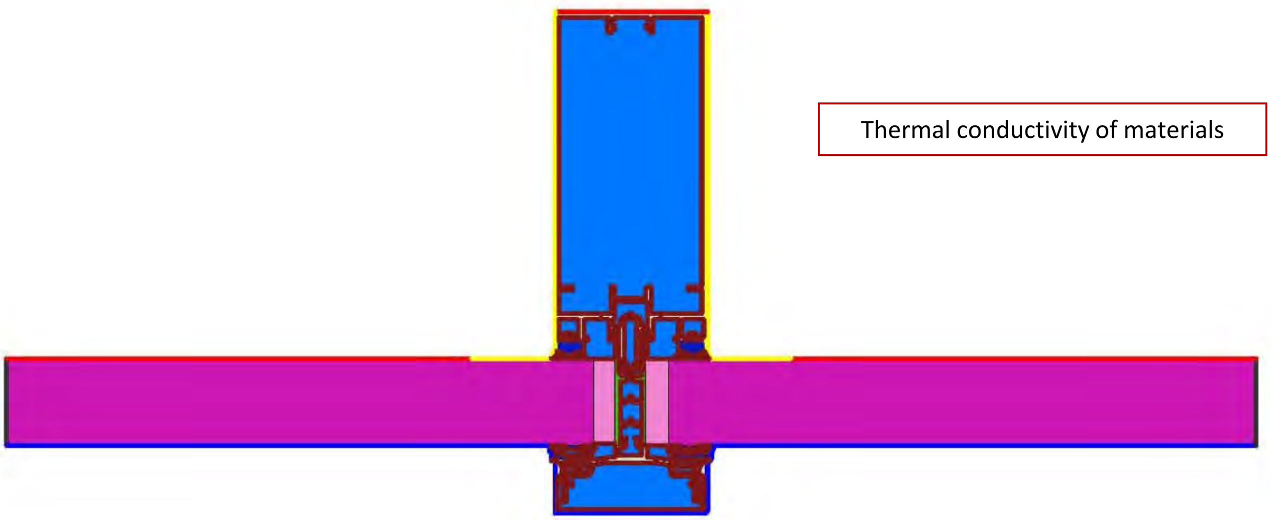
Isotherms – Heat Transfer



Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ \mathrm{W/(m^2 \cdot K)}}$$

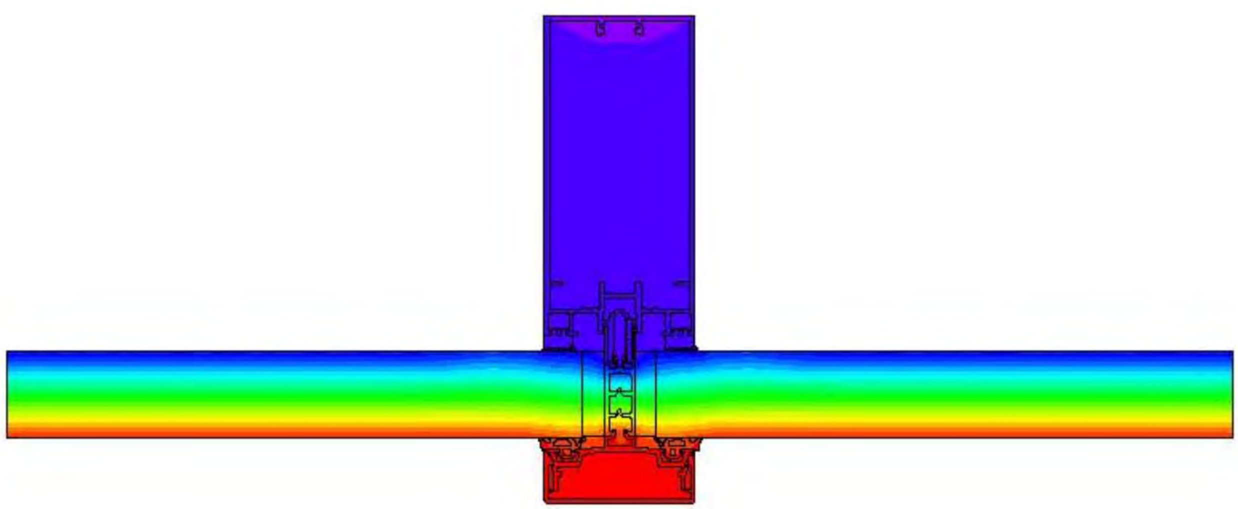
4.8.2 Calculation of Thermal Transmittance of Section 08

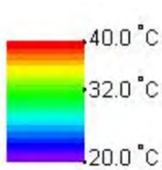


Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

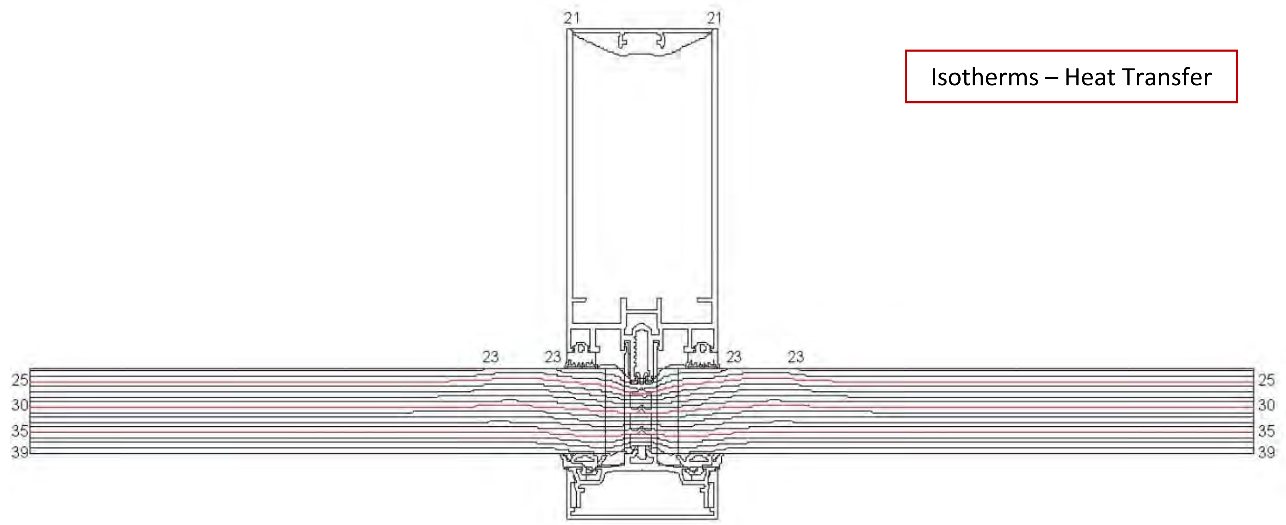
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



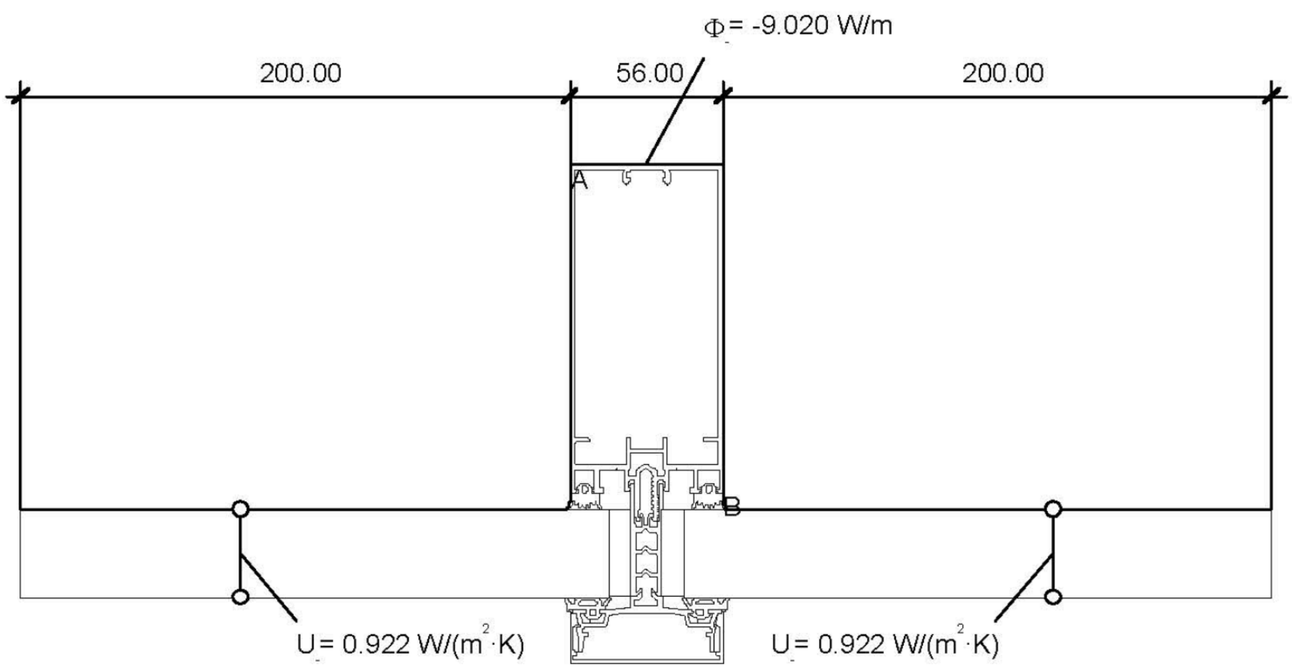


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2 \cdot K)}$$

Thermal transmittance of curtain wall

I- CURTAIN WALL WITH 4 FIXED FIELD				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-04	MAJLIS	5385	3280	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

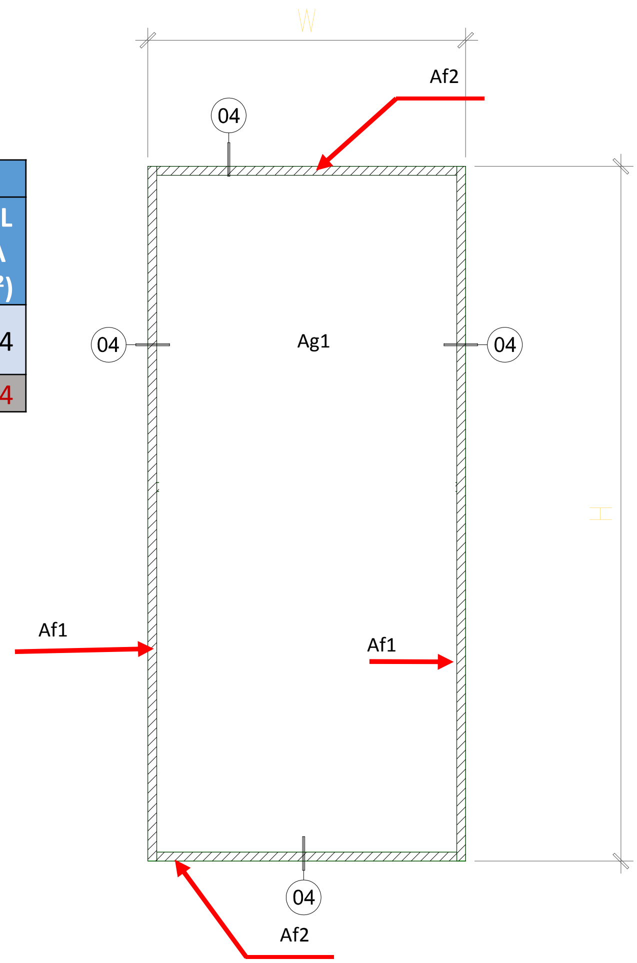
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

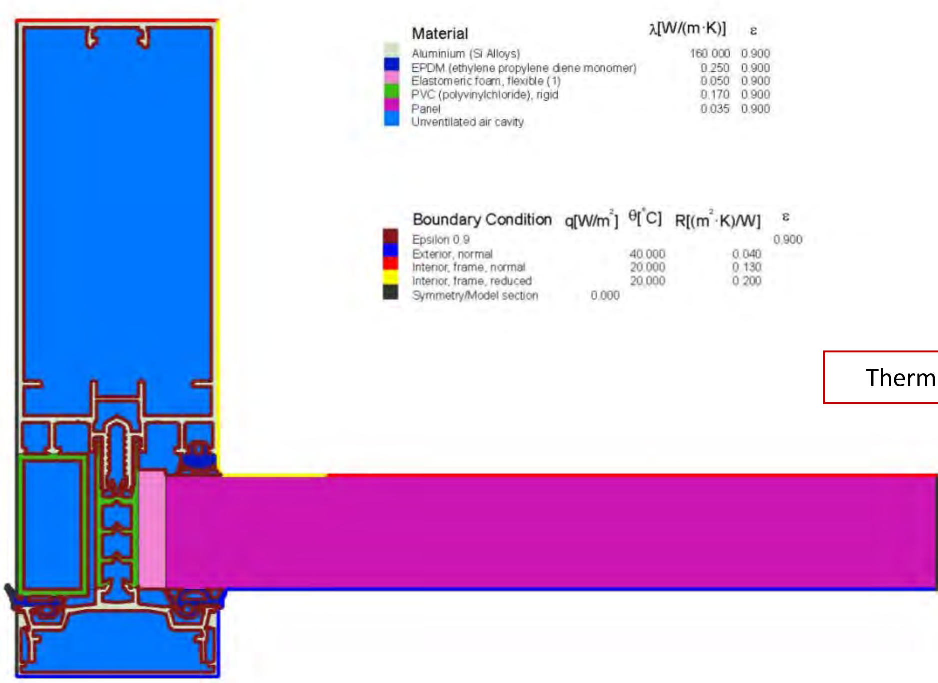
Dimension	Width	in[m]	5.385		Total window Area	in [m²]	17.663
	Height	in[m]	3.280				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	2.642
	Total Frame Area	in [m²]	0.367		Quantity		6.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	15.850
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.998
	Total Frame Area	in [m²]	0.559		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	39.990
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.056	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.887				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	1.814	Total Glass Area		in [m²]	15.850
S Af*Uf =	3.324	in [W/m²K]					
S Ag*Ug =	19.020	in [W/m²K]					
S Af*Uf =	1.9995	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.378**

4.7 CURTAIN WALL – 2 FIXED FIELD

G- CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-11	FAMILY LOBBY	1480	2980	4.4104	1	4.4104
TOTAL					1	4.4104

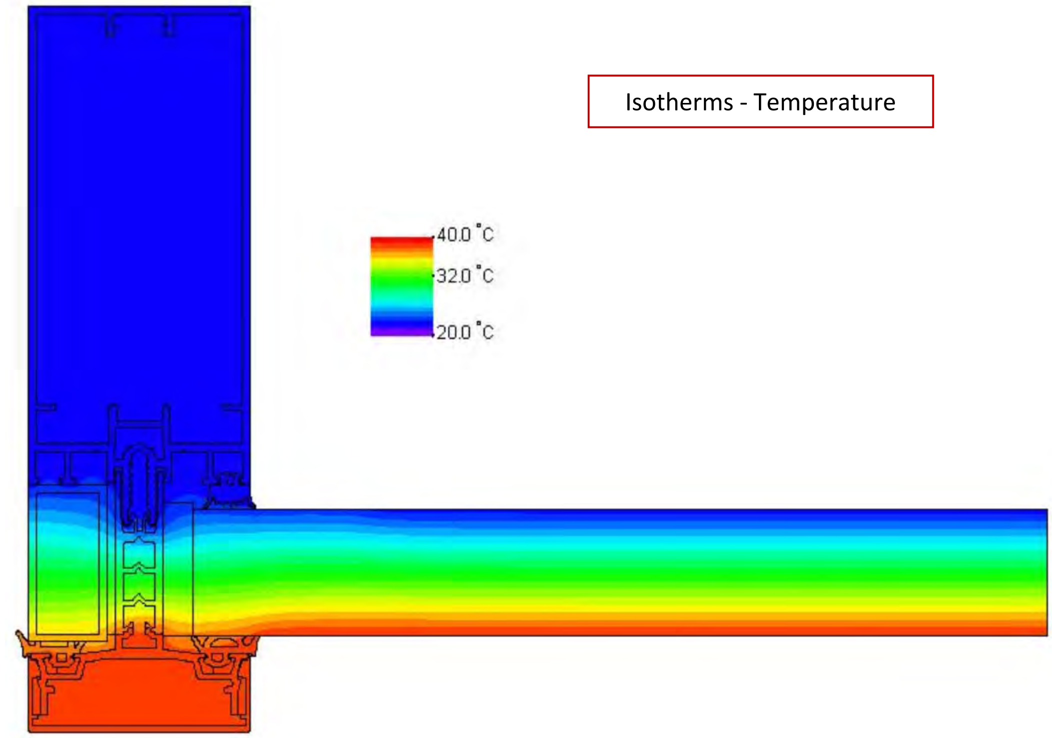


4.7.1 Calculation of Thermal Transmittance of Section 07

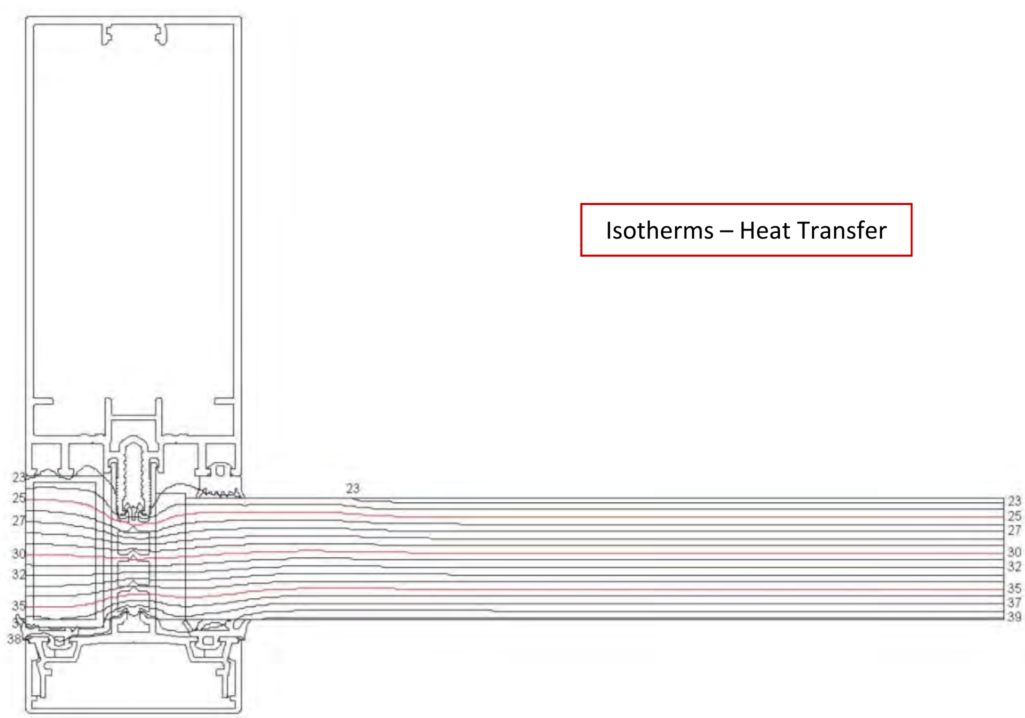


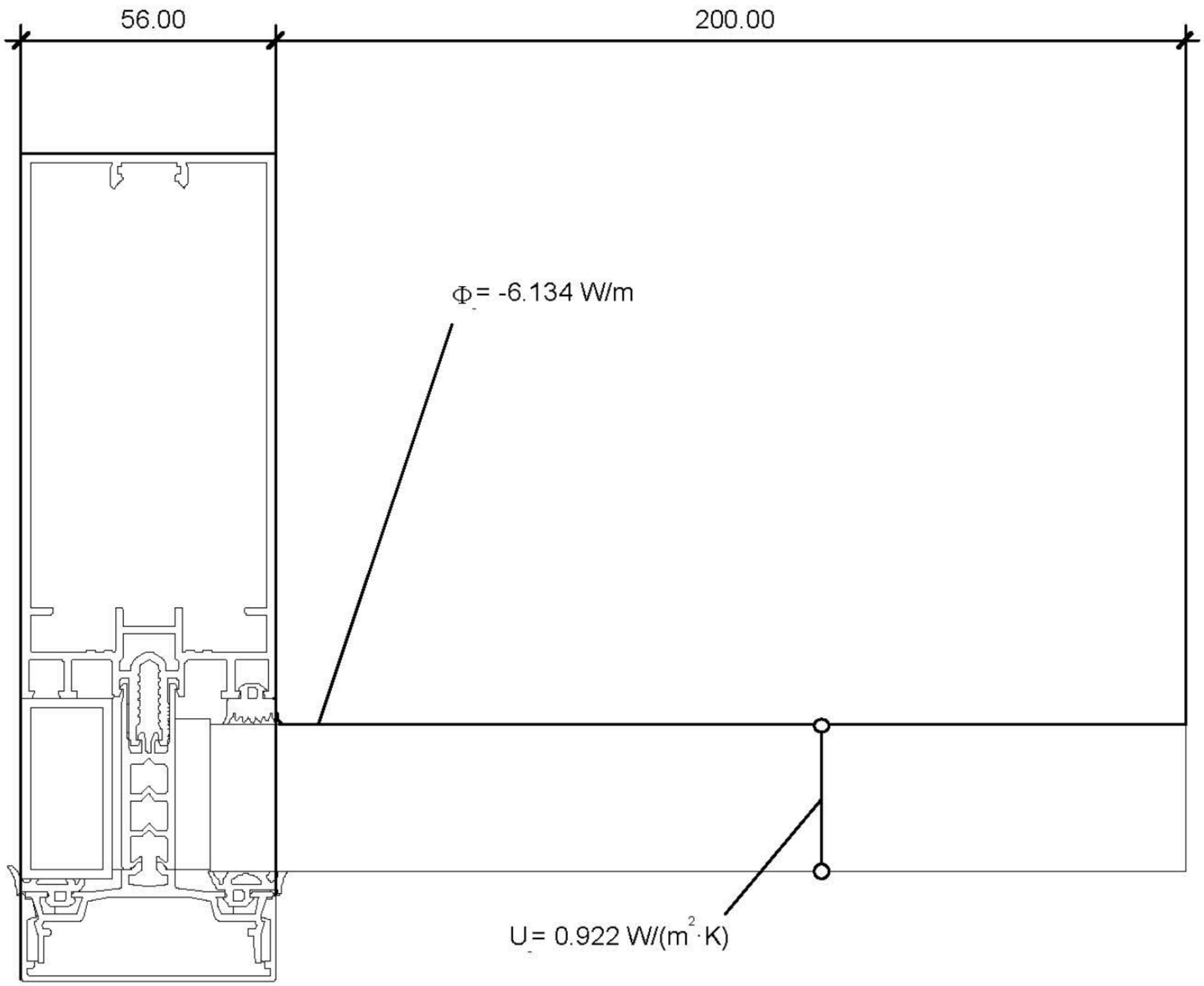
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer





Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ \mathrm{W/(m^2 \cdot K)}}$$

Thermal transmittance of curtain wall

F CURTAIN WALL						
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	AREA (in m²)	QTY	TOTAL AREA (in m²)
CW-11	FAMILY LOBBY	1480	2980	4.4104	1	4.4104
TOTAL					1	4.4104

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

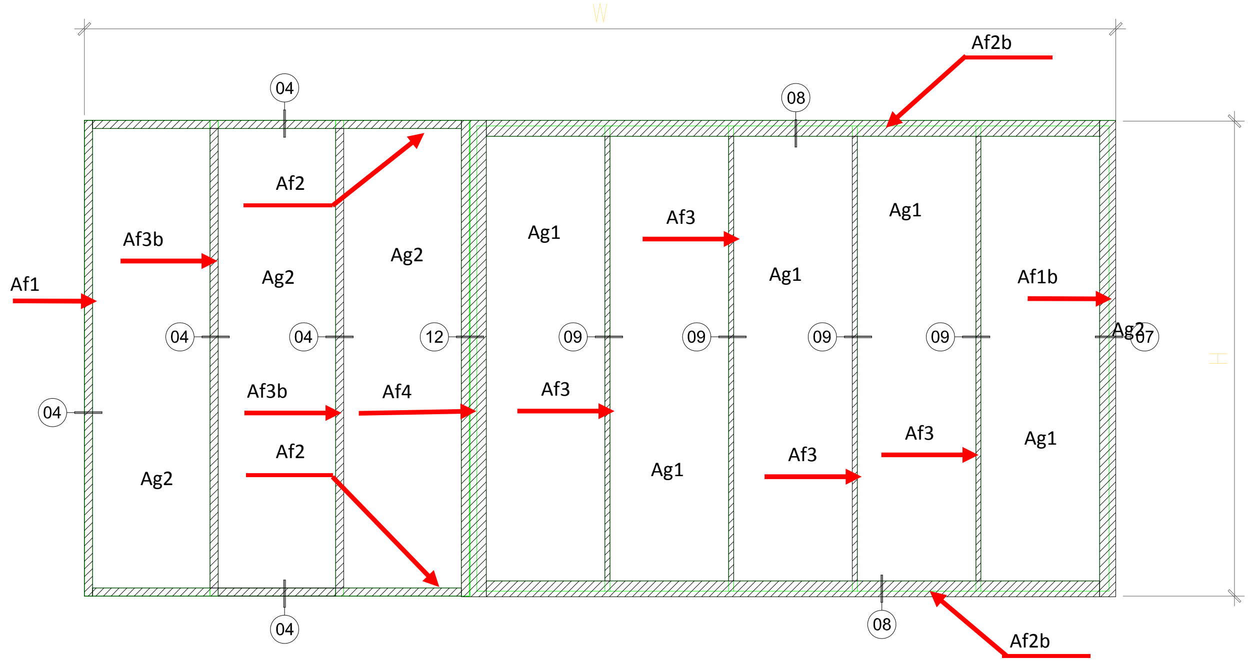
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

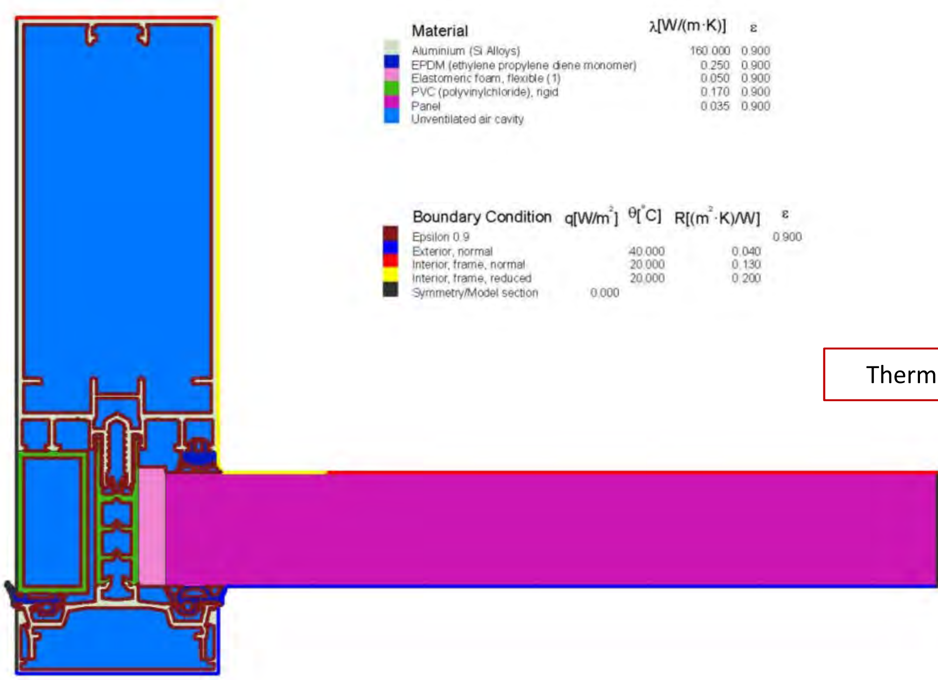
Dimension	Width	in[m]	1.480		Total window Area	in [m²]	4.410
	Height	in[m]	2.980				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	3.868
	Total Frame Area	in [m²]	0.334		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	3.923
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	8.772
	Total Frame Area	in [m²]	0.153		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	8.772
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.000	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.487	Total Glass Area		in [m²]	3.923
S Af*Uf =	1.062	in [W/m²K]					
S Ag*Ug =	4.707	in [W/m²K]					
S Af*Uf =	0.4386	in [W/m²K]		Thermal Transmittance of window (Uw)		in [W/m²K]	1.408

4.7 CURTAIN WALL COMBINED WITH SLIDING DOOR – TYPE 2

REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW 06	FORMAL LIVING	7125	3280	1



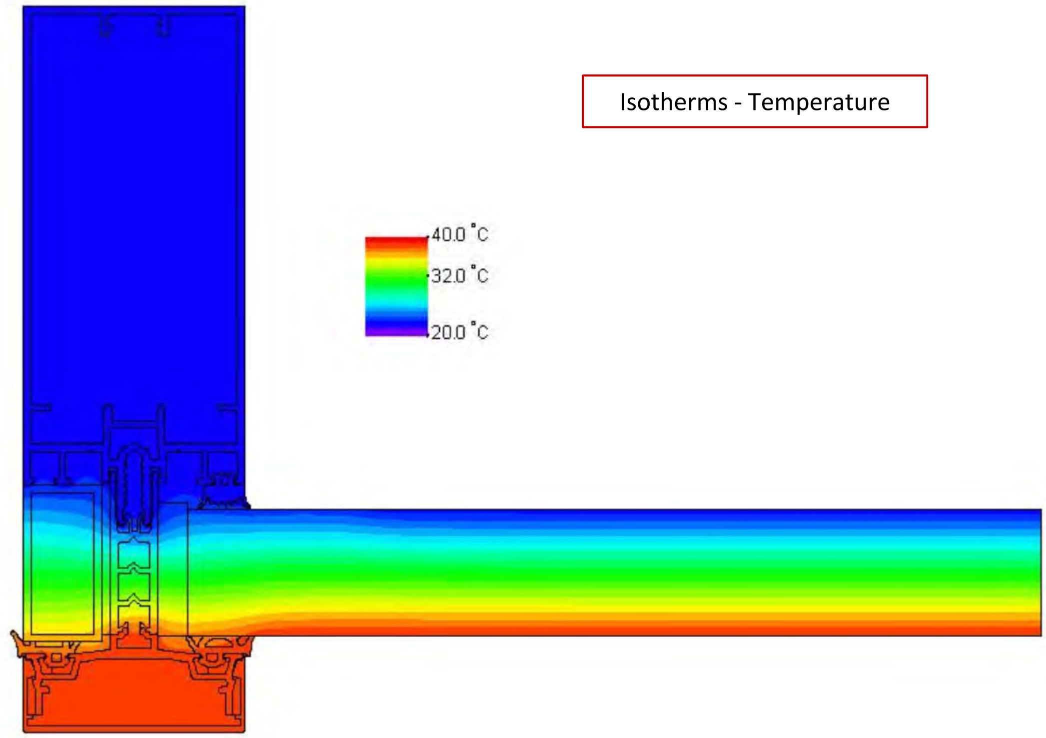
4.7.1 Calculation of Thermal Transmittance of Section 07



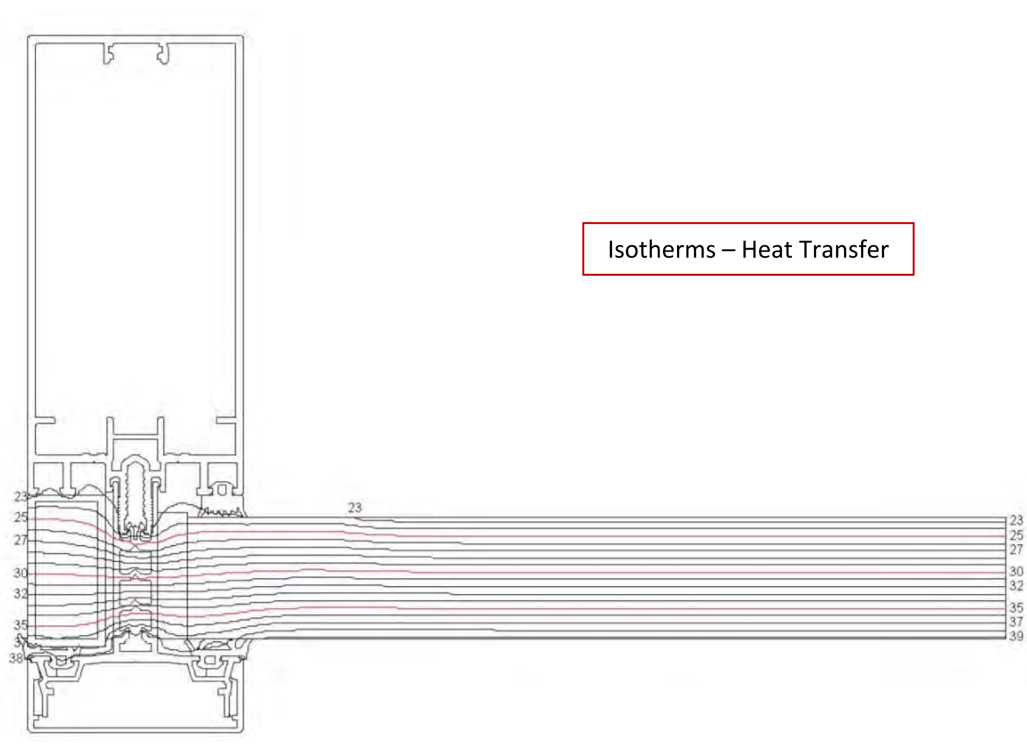
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

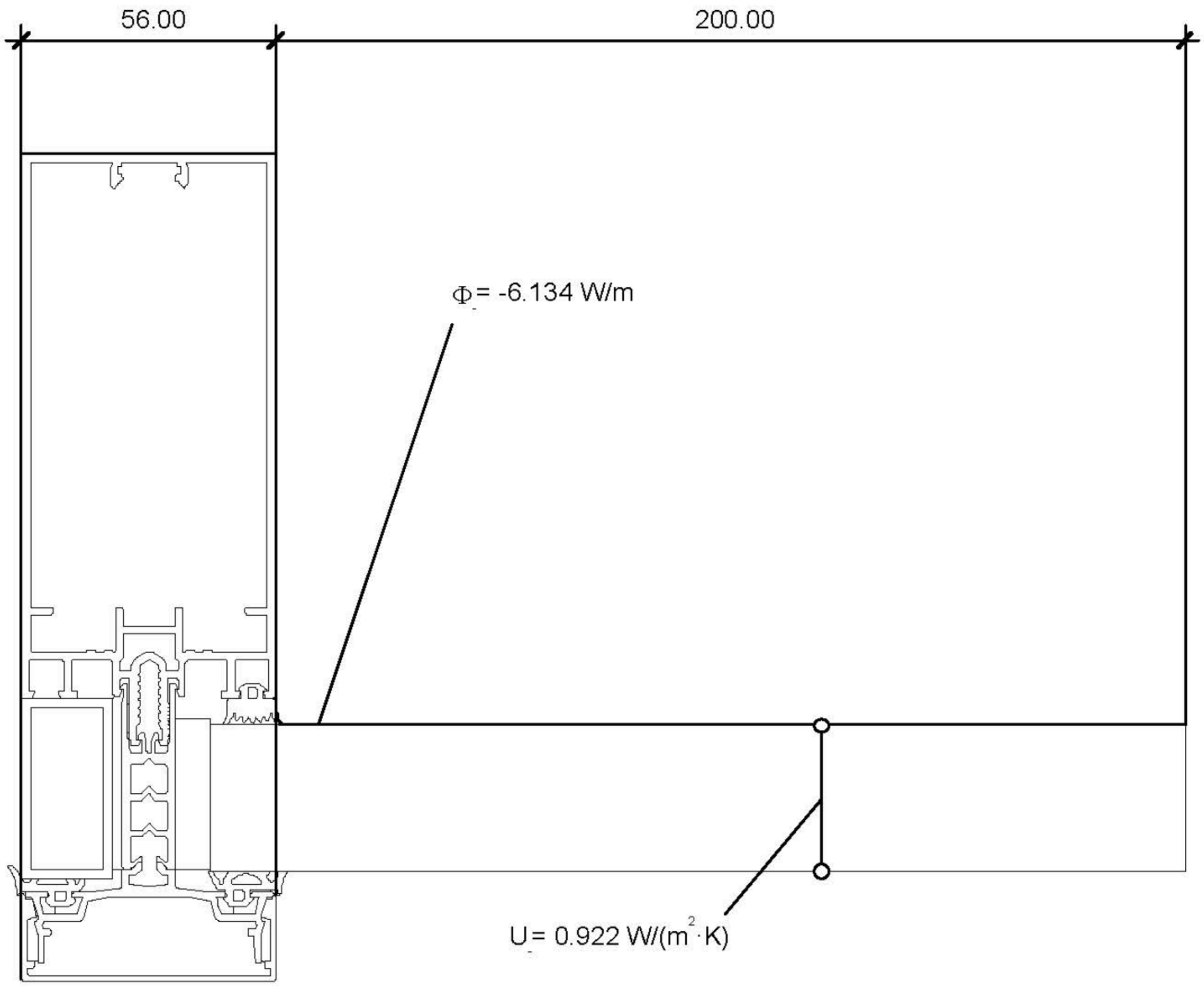
Thermal conductivity of materials



Isotherms - Temperature



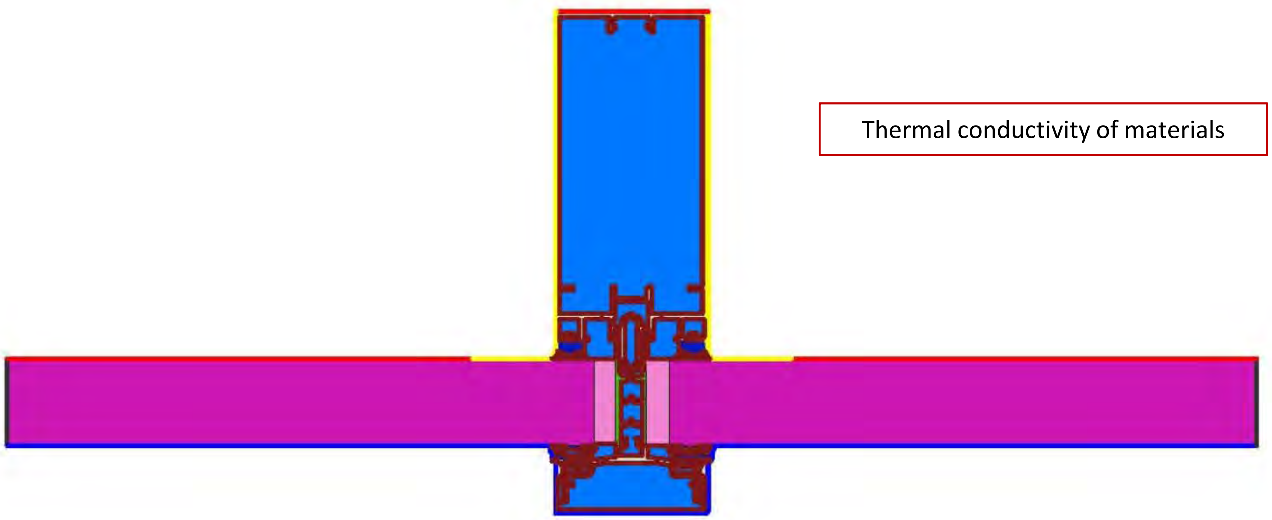
Isotherms – Heat Transfer



Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

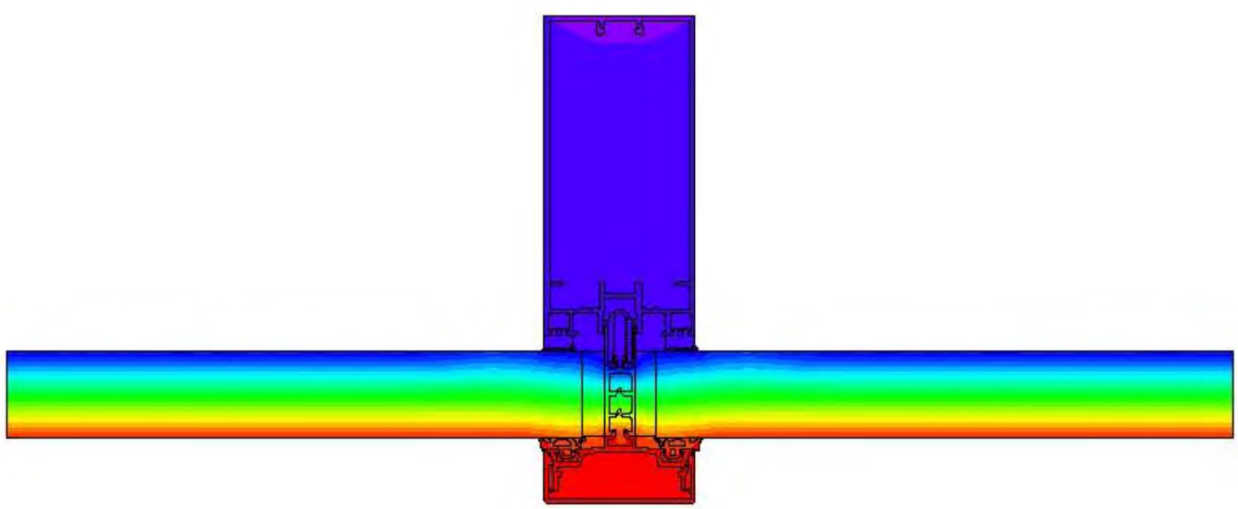
4.7.2 Calculation of Thermal Transmittance of Section 08

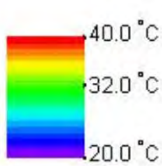


Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

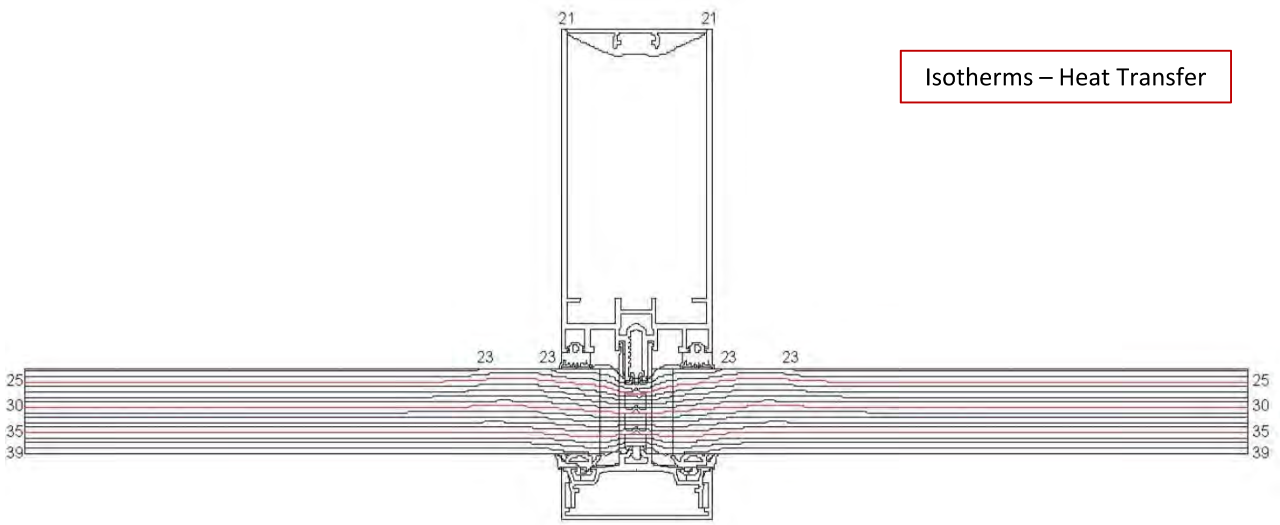
Boundary Condition	q[W/m^2]	θ[°C]	R[(m^2·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



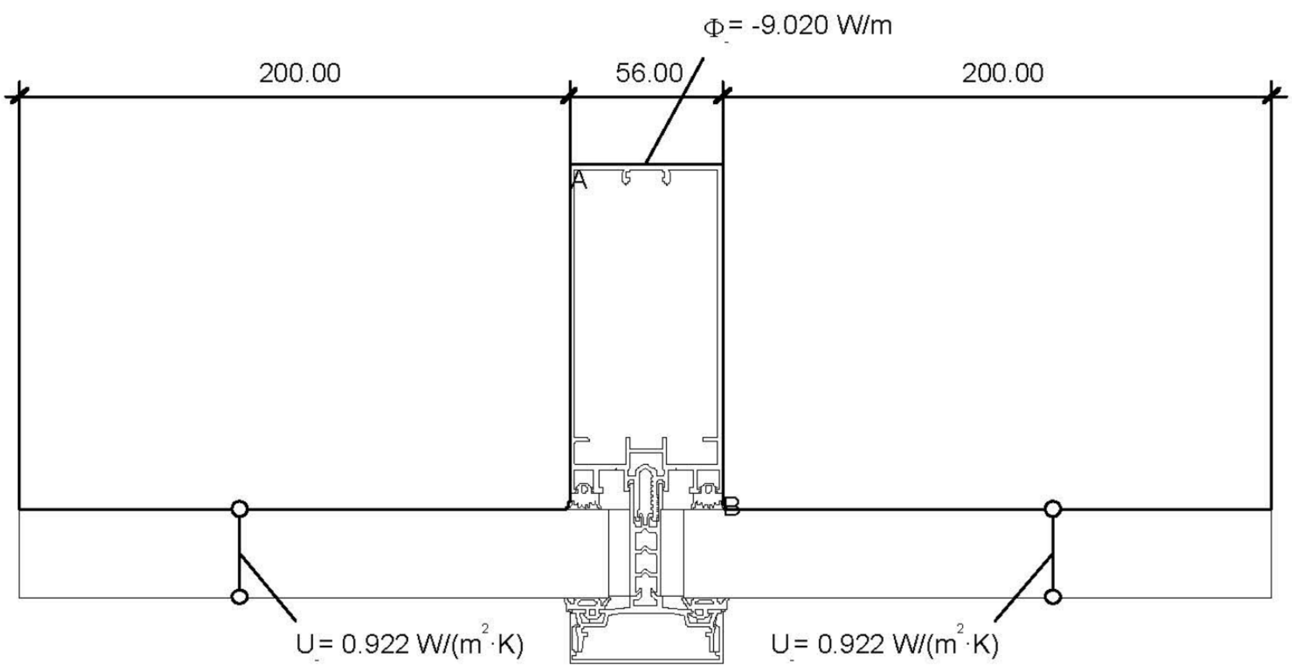


Isotherms - Temperature

Isotherms – Heat Transfer

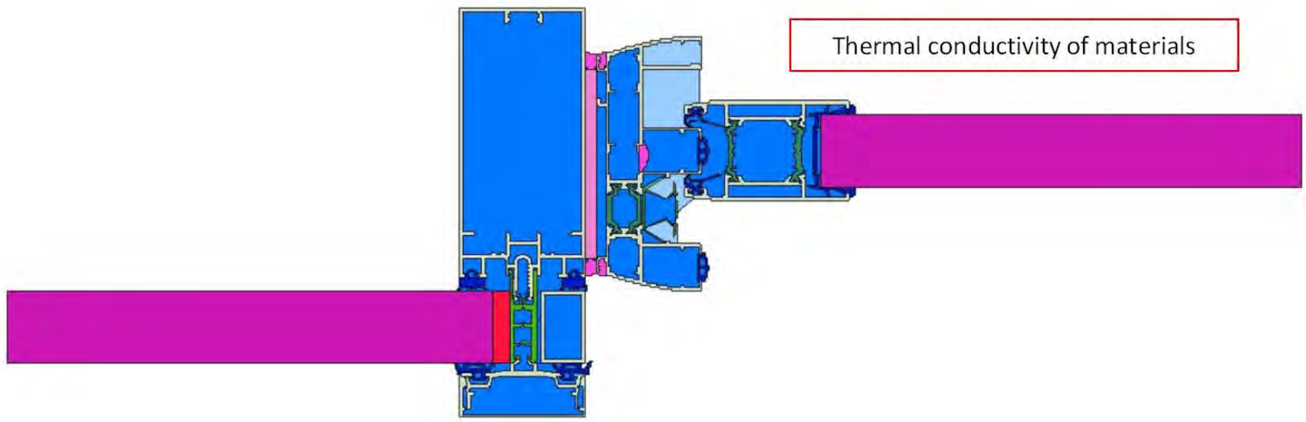


Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2 \cdot K)}$$

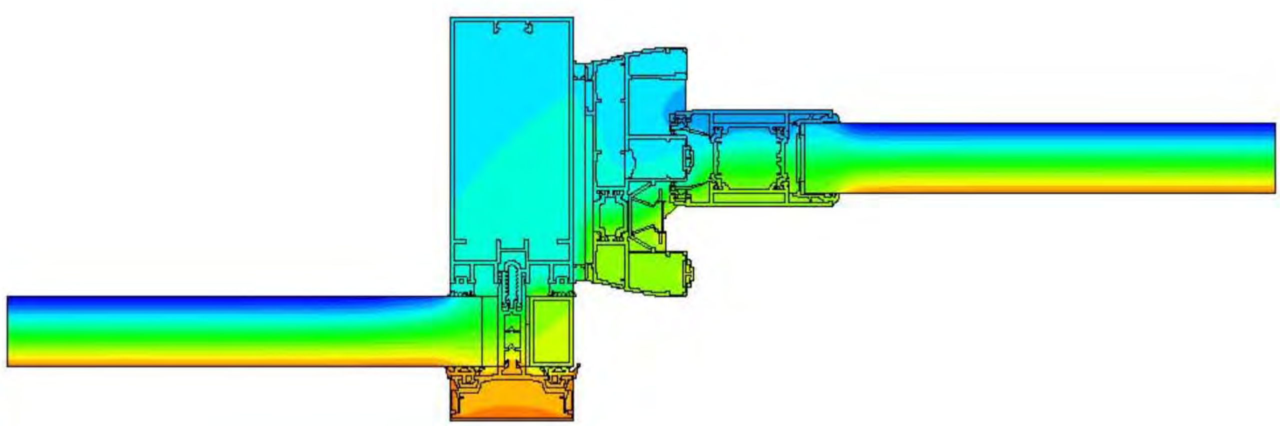
4.7.3 Calculation of Thermal Transmittance of Section 08

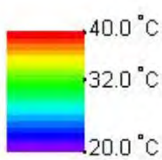


Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PU (polyurethane)	0.400	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Silicone, pure (1)	0.350	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

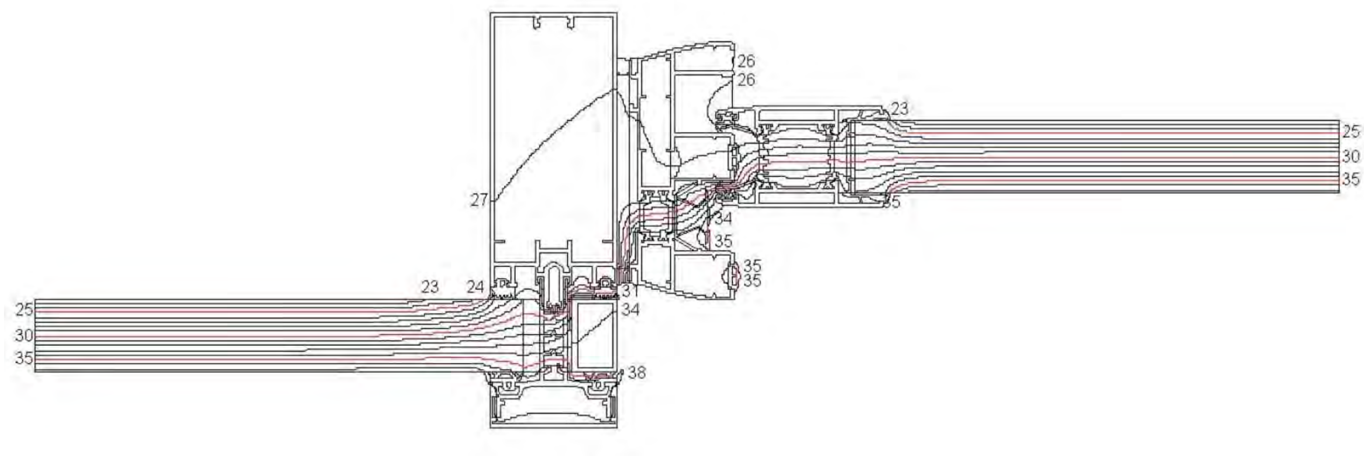
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, ventilated		40.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



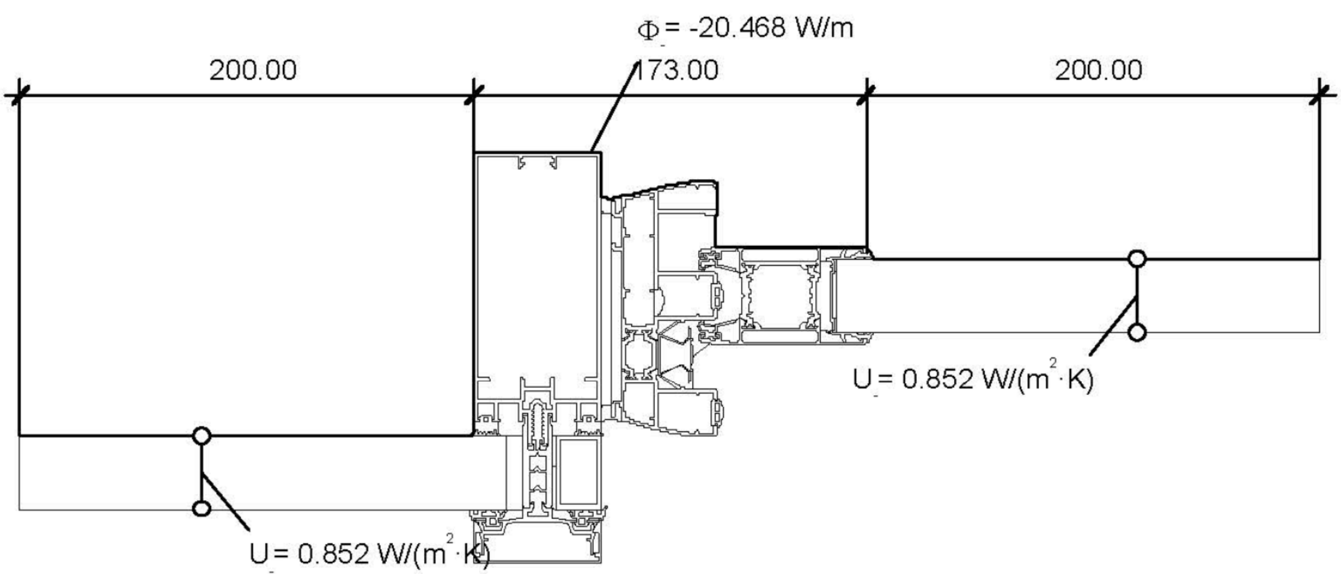


Isotherms - Temperature

Isotherms – Heat Transfer



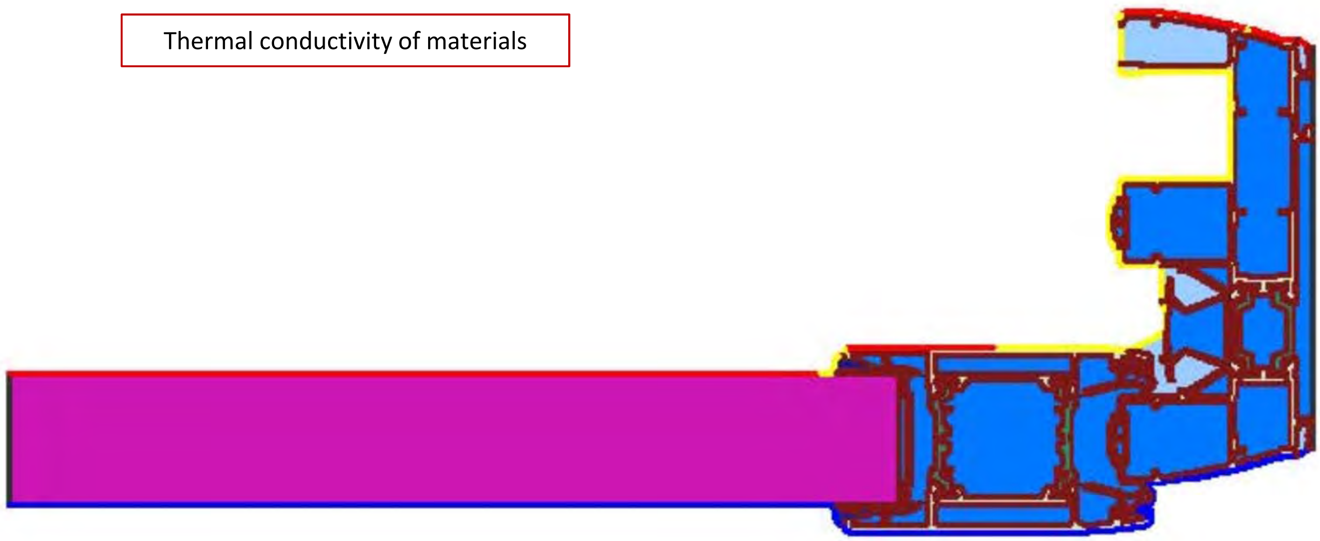
Thermal section transmittance



$$U_{f,} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{20.468}{20.000} - 0.852 \cdot 0.200 - 0.852 \cdot 0.200}{0.173} = \boxed{3.95\ W/(m^2 \cdot K)}$$

4.7.4 Calculation of Thermal Transmittance of Section 03

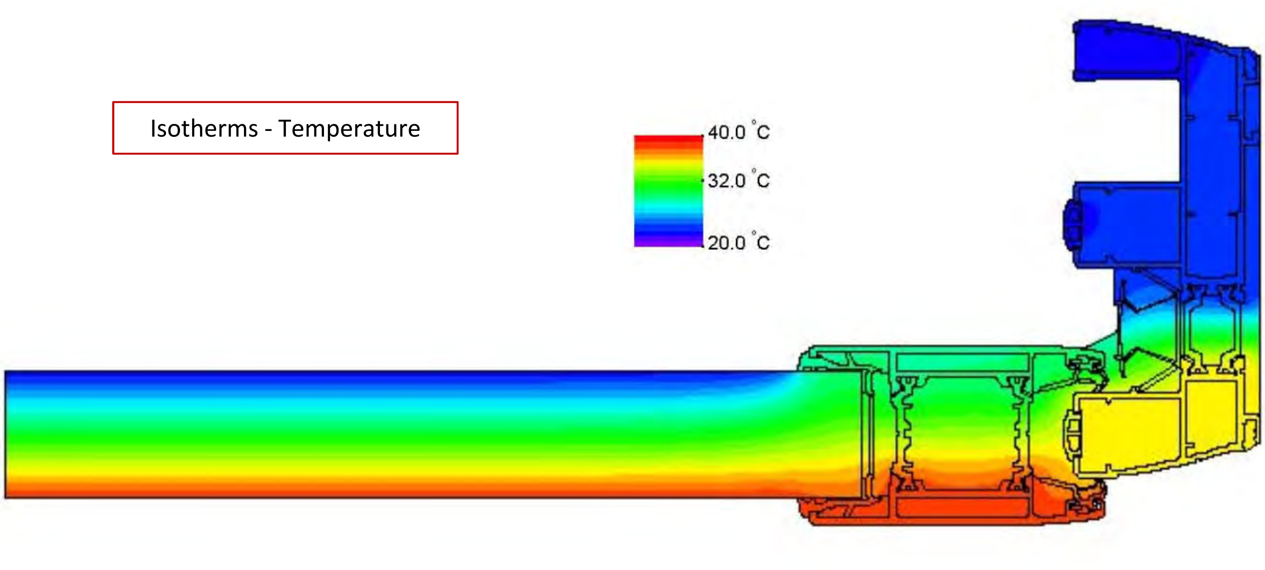
Thermal conductivity of materials



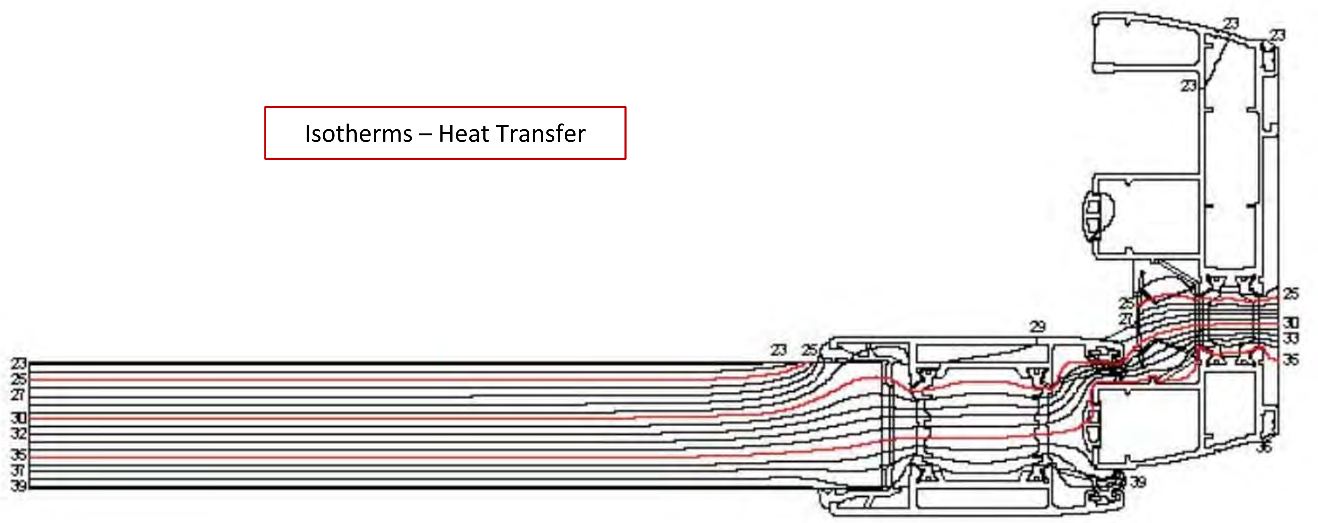
Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
PVC, flexible (PVC-P) 40% softener	0.140	0.900
Panel	0.035	0.900
Polyamid (nylon)	0.250	
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

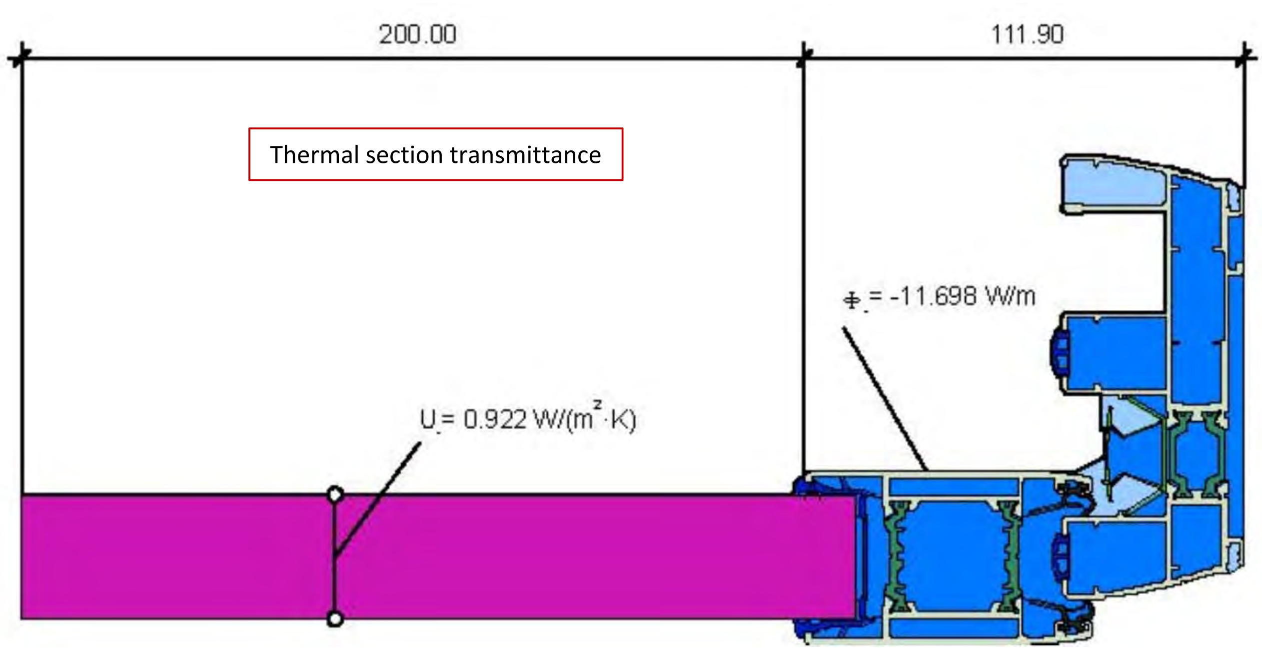
Isotherms - Temperature



Isotherms – Heat Transfer

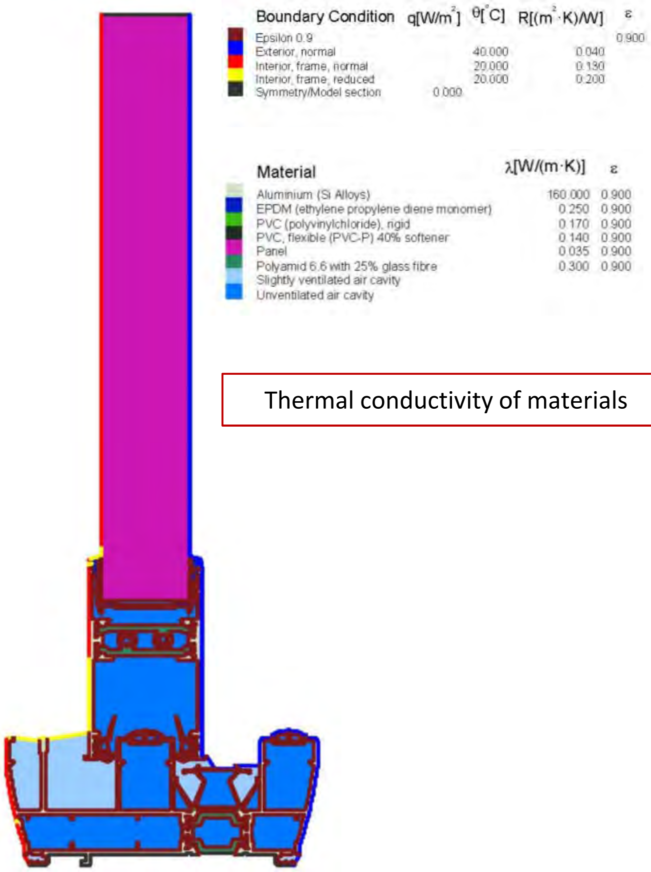


Thermal section transmittance

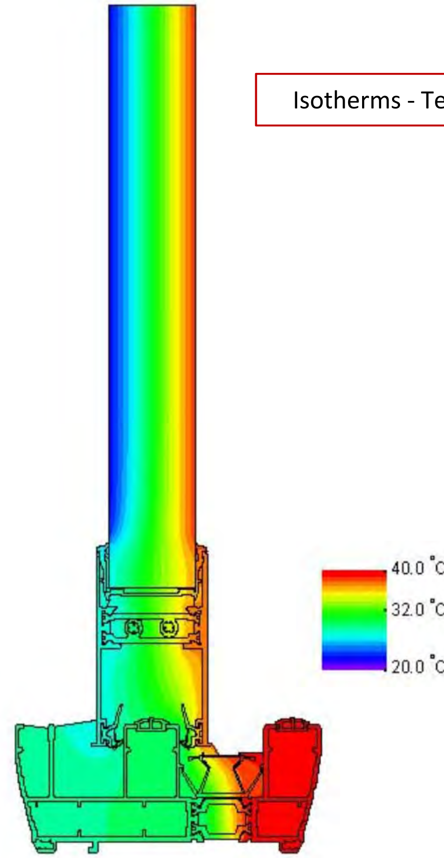


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.698}{20.000} - 0.922 \cdot 0.200}{0.112} = \boxed{3.58\ W/(m^2 \cdot K)}$$

4.7.5 Calculation of Thermal Transmittance of Section 04

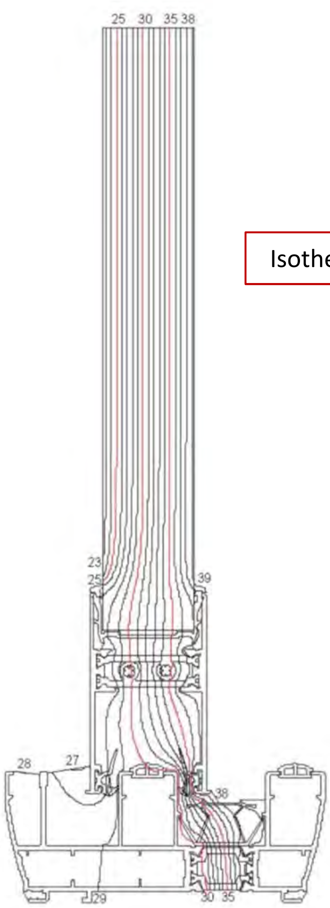


Thermal conductivity of materials



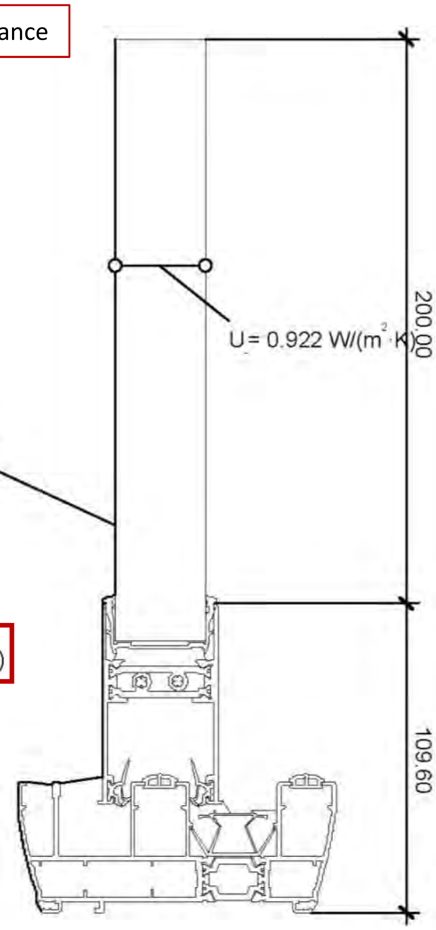
Isotherms - Temperature

Thermal section transmittance

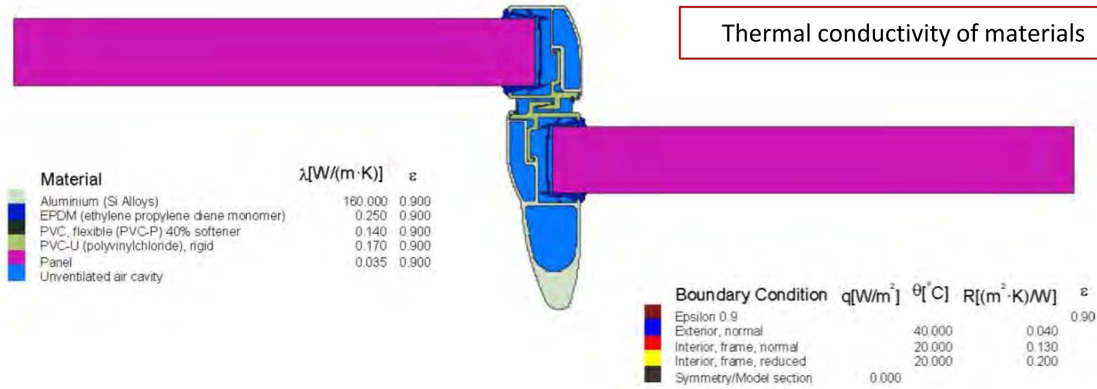


Isotherms – Heat Transfer

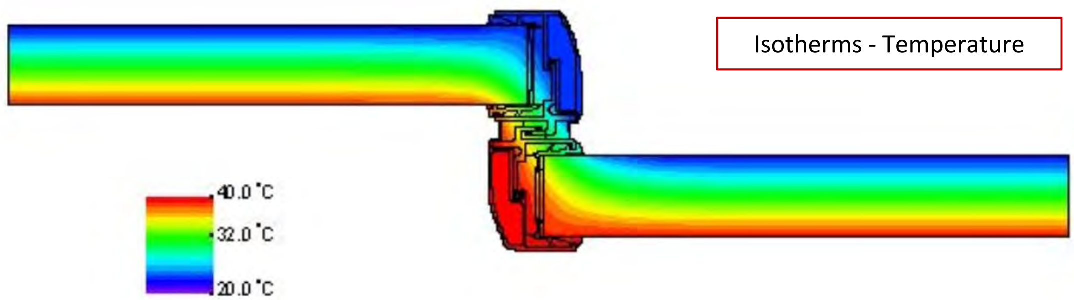
$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$



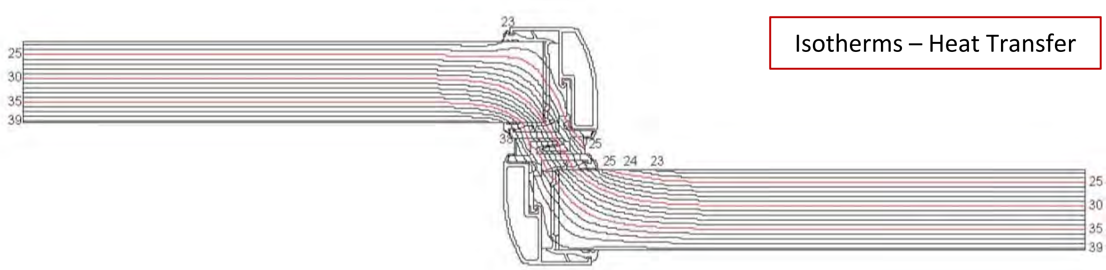
4.7.6 Calculation of Thermal Transmittance of Section 05



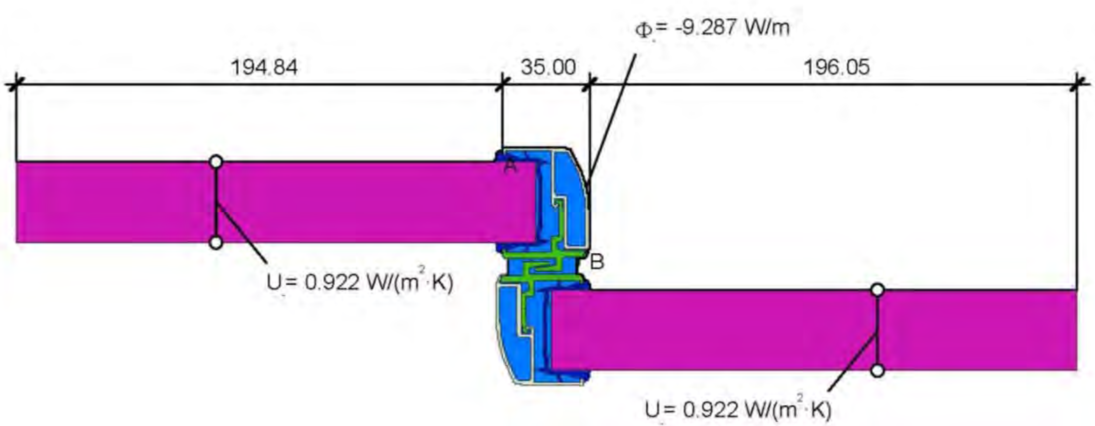
Thermal conductivity of materials



Isotherms - Temperature



Isotherms – Heat Transfer



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97\ \text{W/(m}^2\cdot\text{K)}$$

Thermal section transmittance

Thermal transmittance of curtain wall

REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW 03	FORMAL LIVING	7125	3280	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

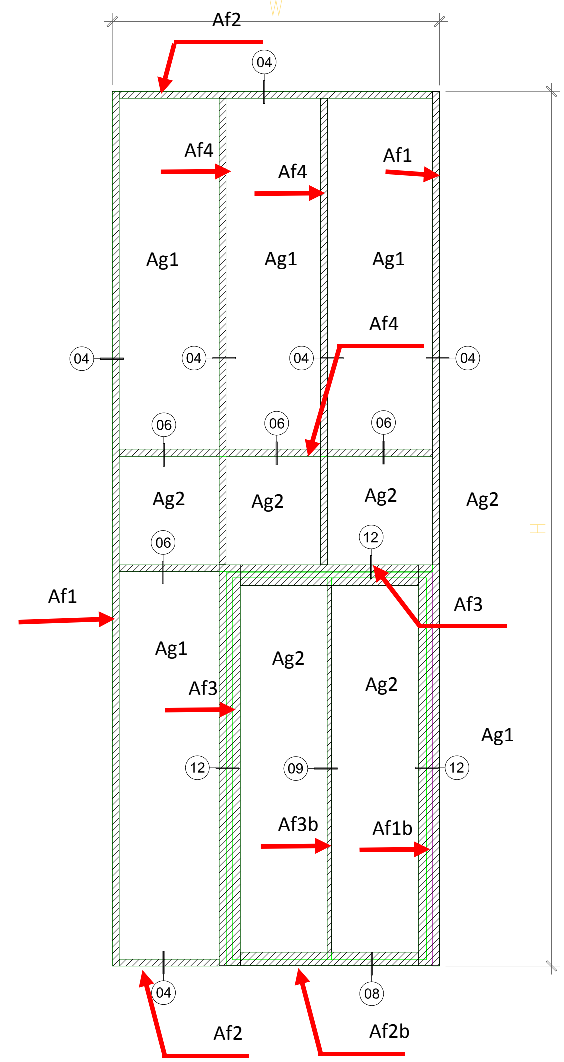
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

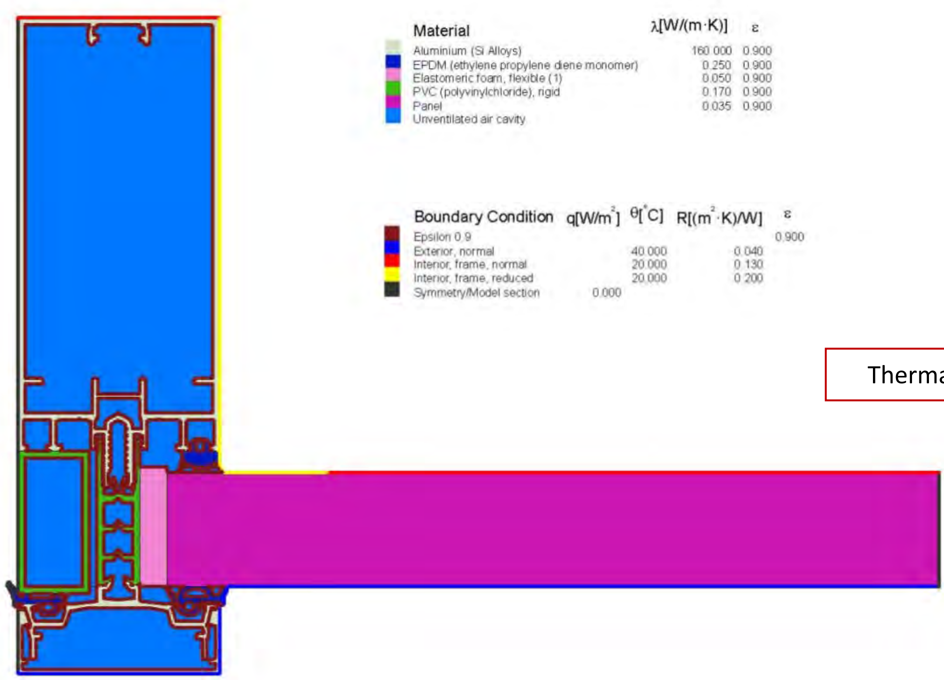
Dimension	Width	in[m]	7.125		Total window Area	in [m²]	23.370
	Height	in[m]	3.280				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	2.576
	Total Frame Area	in [m²]	0.184		Quantity		3.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	7.717
Frame area Af1b	Exposed surface	in[m]	0.110	Glass area Ag2	Surface / unit	in [m²]	2.538
	Total Frame Area	in [m²]	0.361		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	3.580		Total Surface	in [m²]	12.688
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.970
	Total Frame Area	in [m²]	0.273		Quantity		3.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	23.910
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	7.780
	Total Frame Area	in [m²]	0.901		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	38.900
Frame area Af3	Exposed surface	in[m]	0.035	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.459				
	Thermal Transmittance	in [W/m²K]	3.950			in [W/m²K]	1.200
Frame area Af3b	Exposed surface	in[m]	0.056	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.367				
	Thermal Transmittance	in [W/m²K]	2.970			in [W/mK]	0.050
Frame area Af4	Exposed surface	in[m]	0.128				
	Total Frame Area	in [m²]	0.420				
	Thermal Transmittance	in [W/m²K]	1.470				
Total Frame Area		in [m²]	2.965	Total Glass Area		in [m²]	20.405
S Af*Uf =	8.908	in [W/m²K]					
S Ag*Ug =	24.486	in [W/m²K]					
S Af*Uf =	3.1405	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.563**

4.8 CURTAIN WALL

F - CURTAIN WALL				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW-21	Family living	2680	7180	1
TOTAL				1

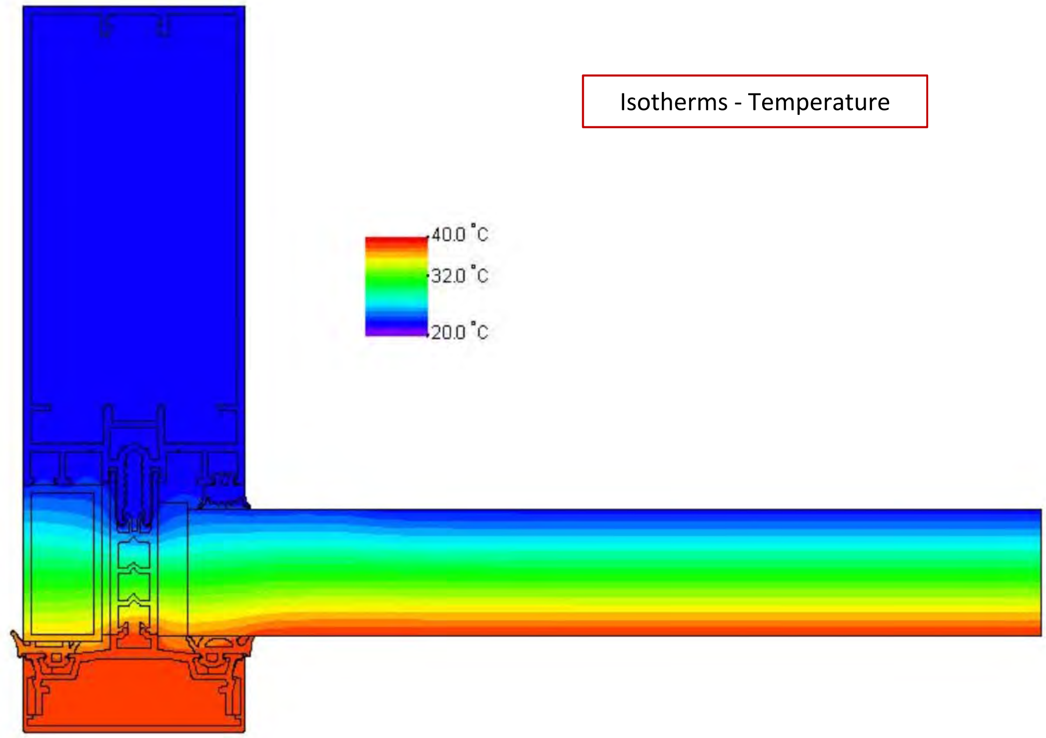


4.8.1 Calculation of Thermal Transmittance of Section 07

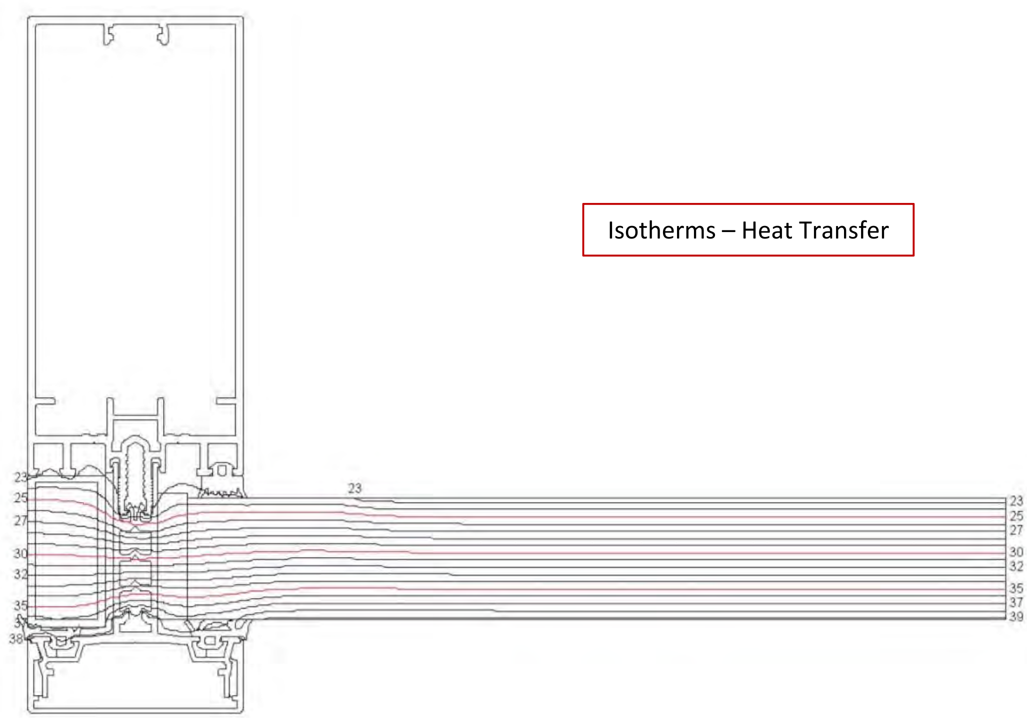


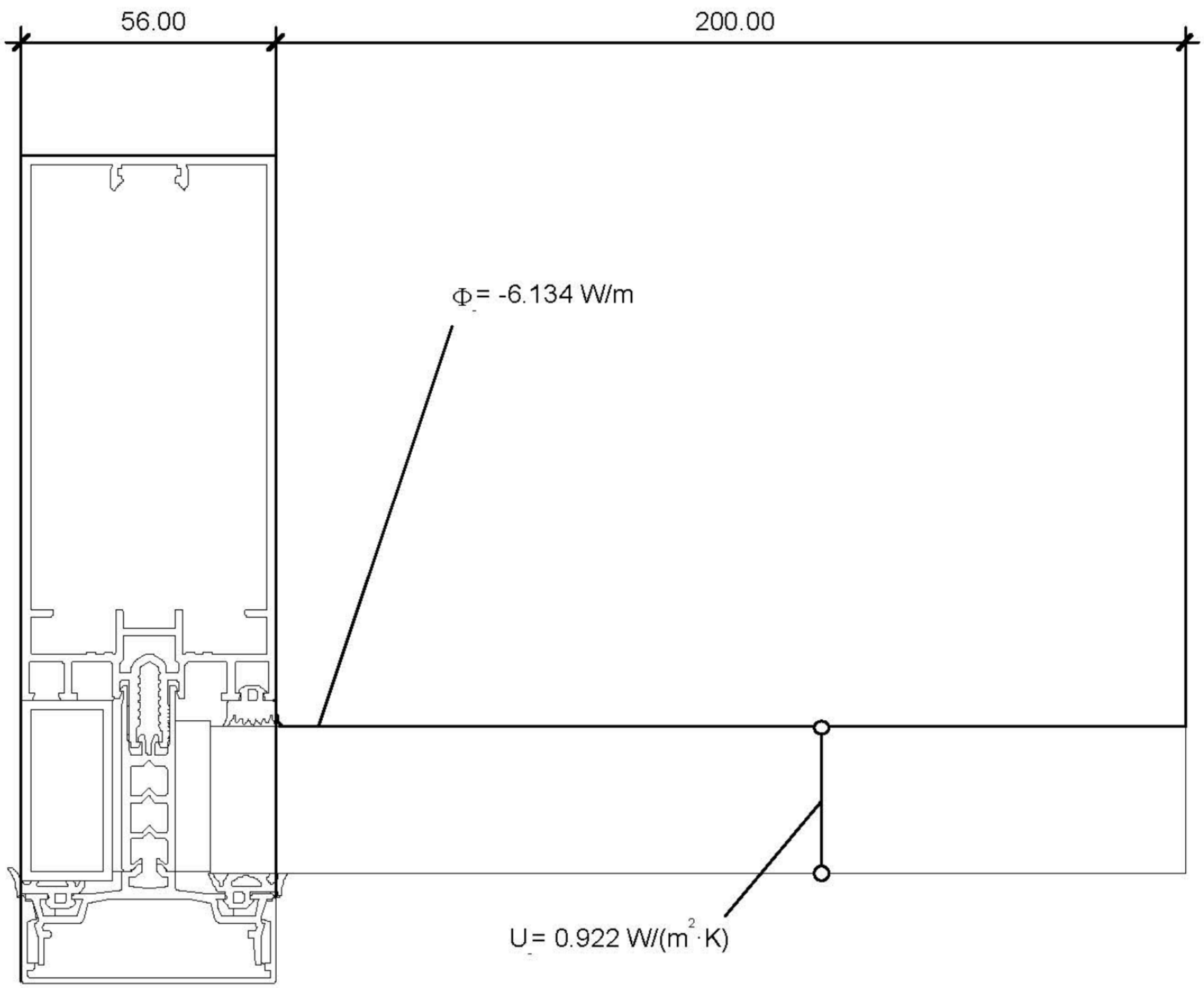
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer

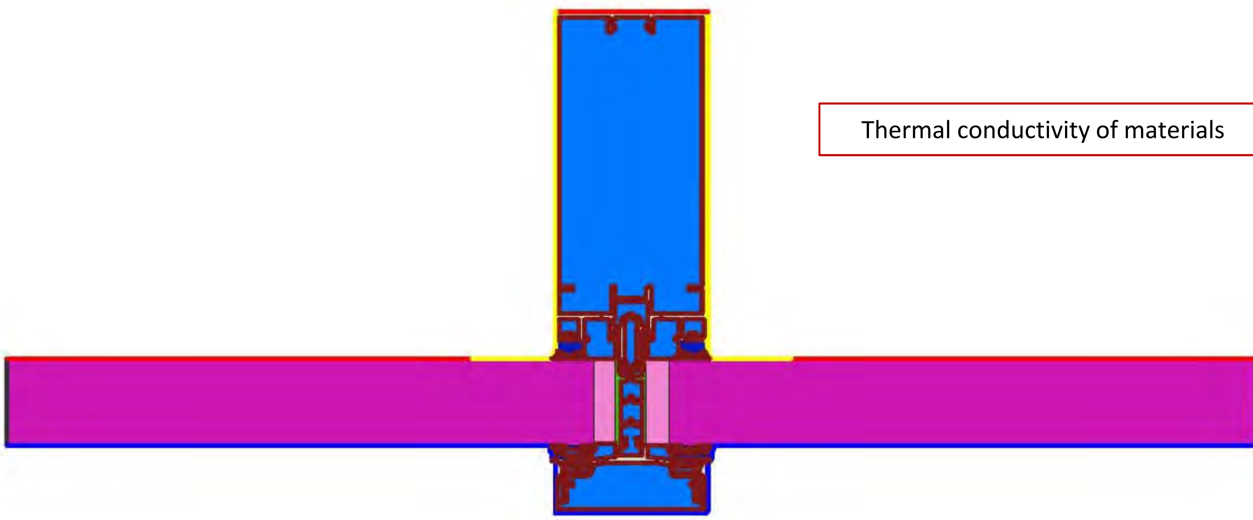




Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

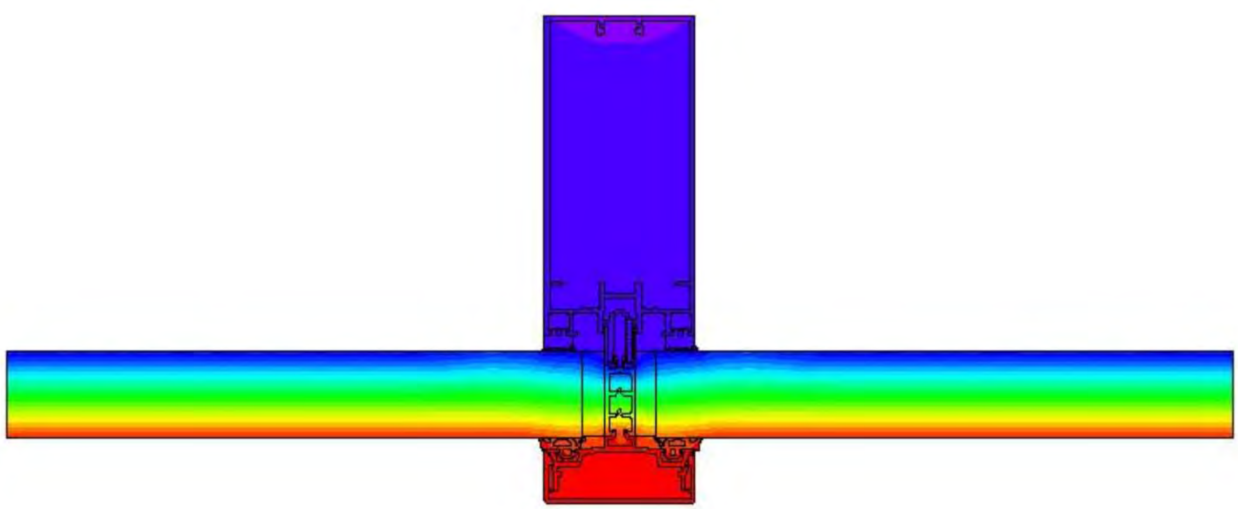
4.7.2 Calculation of Thermal Transmittance of Section 08

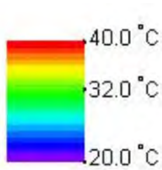


Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

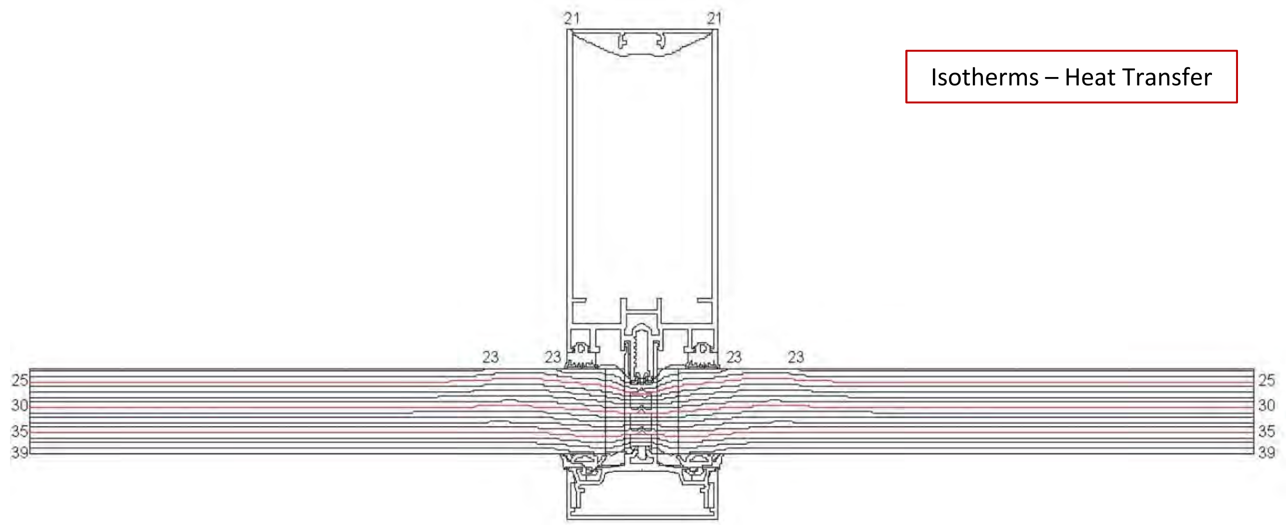
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



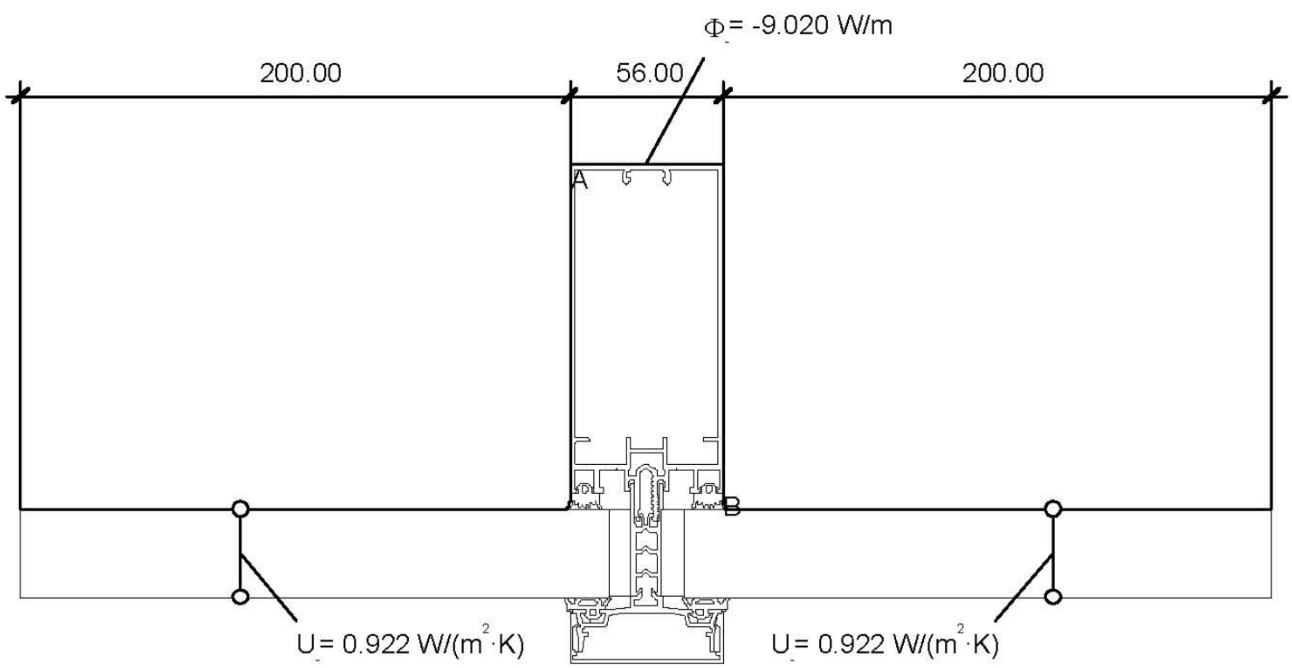


Isotherms - Temperature

Isotherms – Heat Transfer



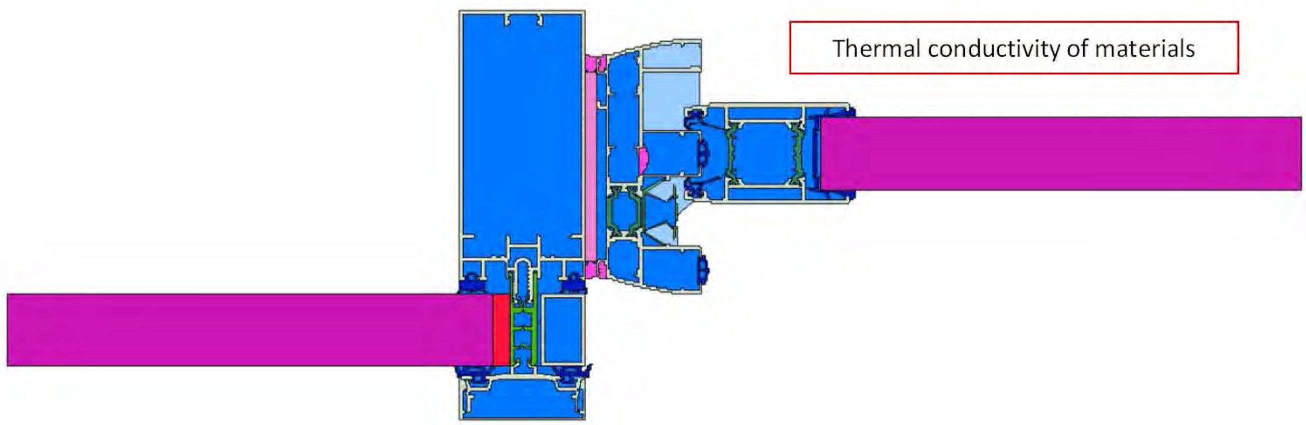
Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922 \cdot 0.200 - 0.922 \cdot 0.200}{0.056} = \boxed{1.47\ W/(m^2 \cdot K)}$$

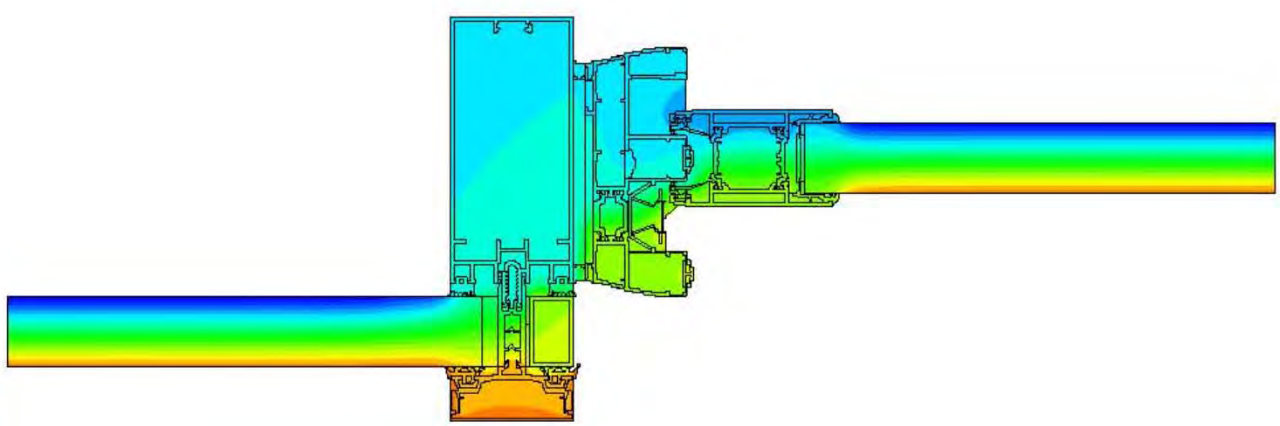
4.7.3 Calculation of Thermal Transmittance of Section 08

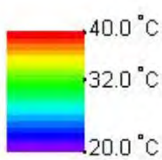
Thermal conductivity of materials



Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PU (polyurethane)	0.400	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glass fibre	0.300	0.900
Silicone, pure (1)	0.350	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

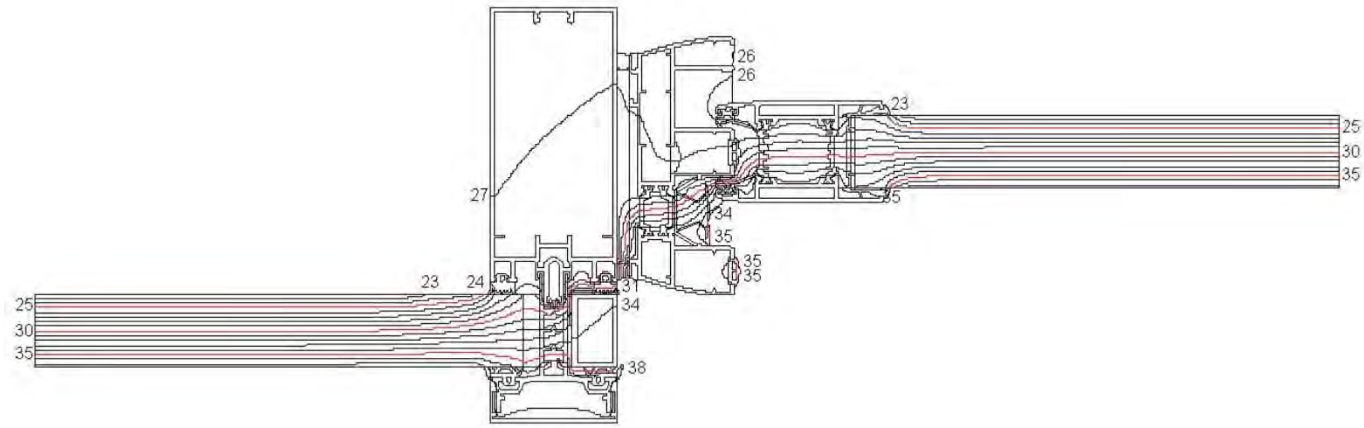
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, ventilated		40.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



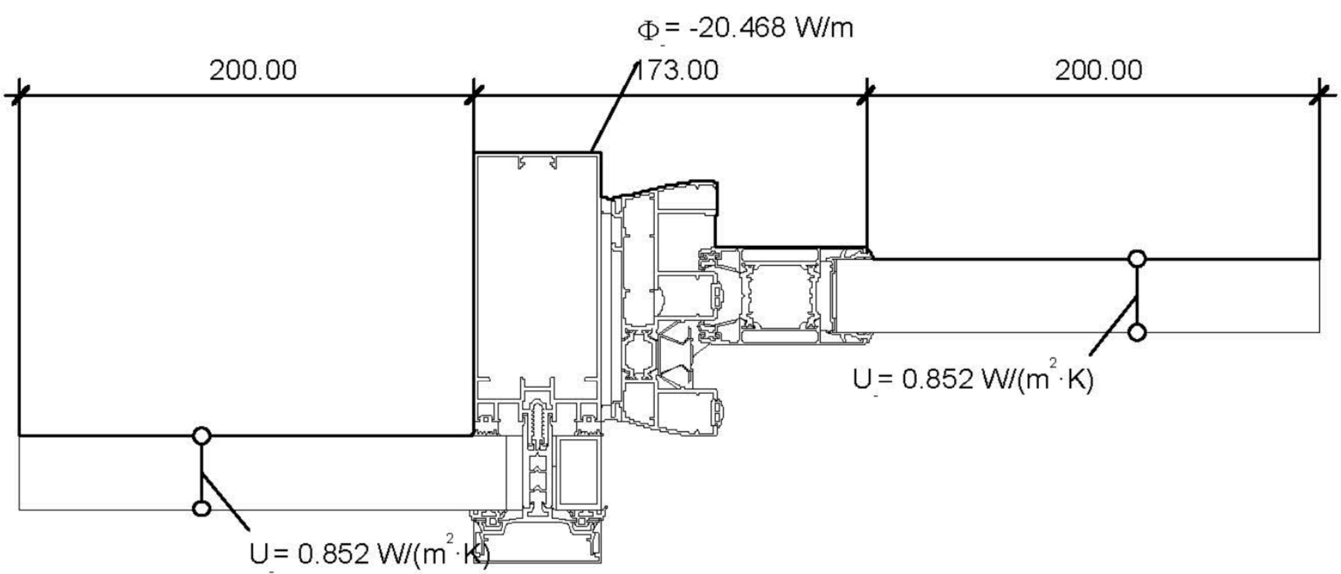


Isotherms - Temperature

Isotherms – Heat Transfer

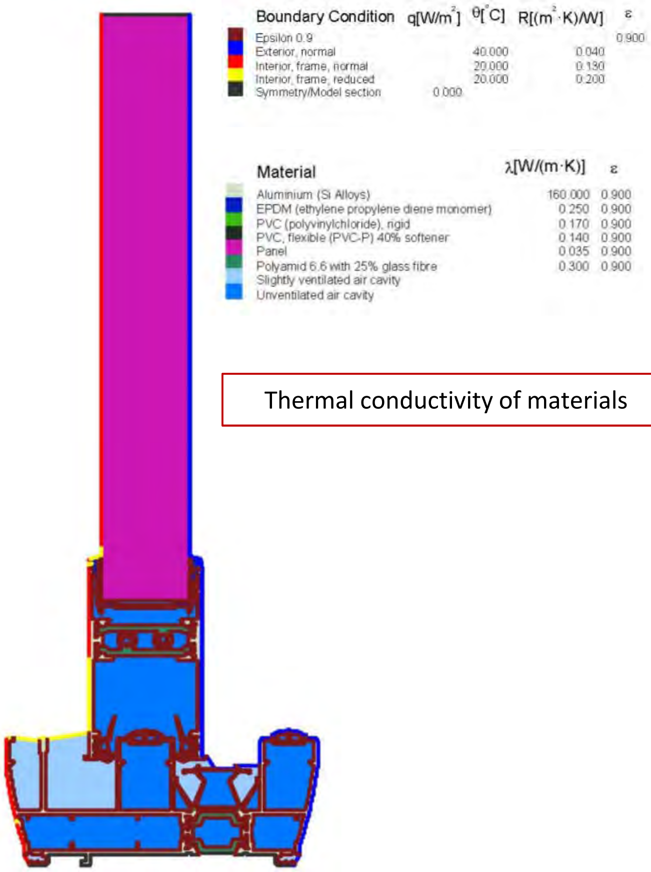


Thermal section transmittance

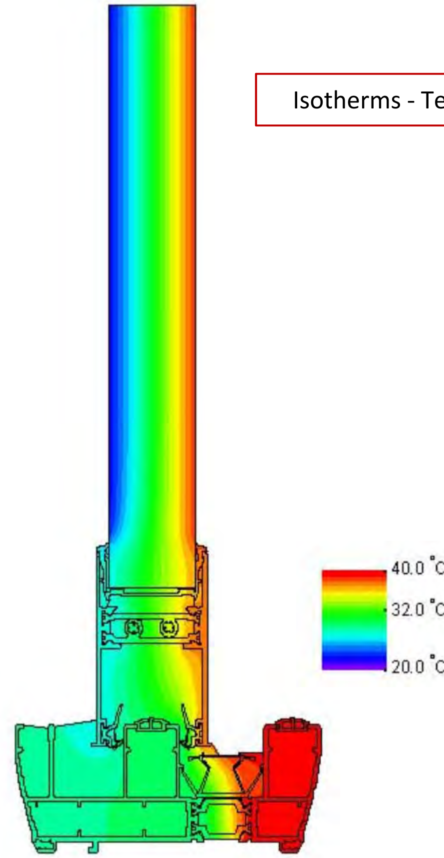


$$U_{f,} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{20.468}{20.000} - 0.852 \cdot 0.200 - 0.852 \cdot 0.200}{0.173} = \boxed{3.95\ W/(m^2 \cdot K)}$$

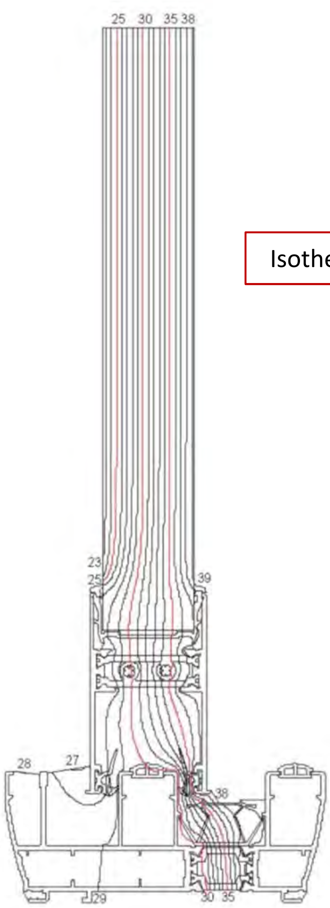
4.7.5 Calculation of Thermal Transmittance of Section 04



Thermal conductivity of materials

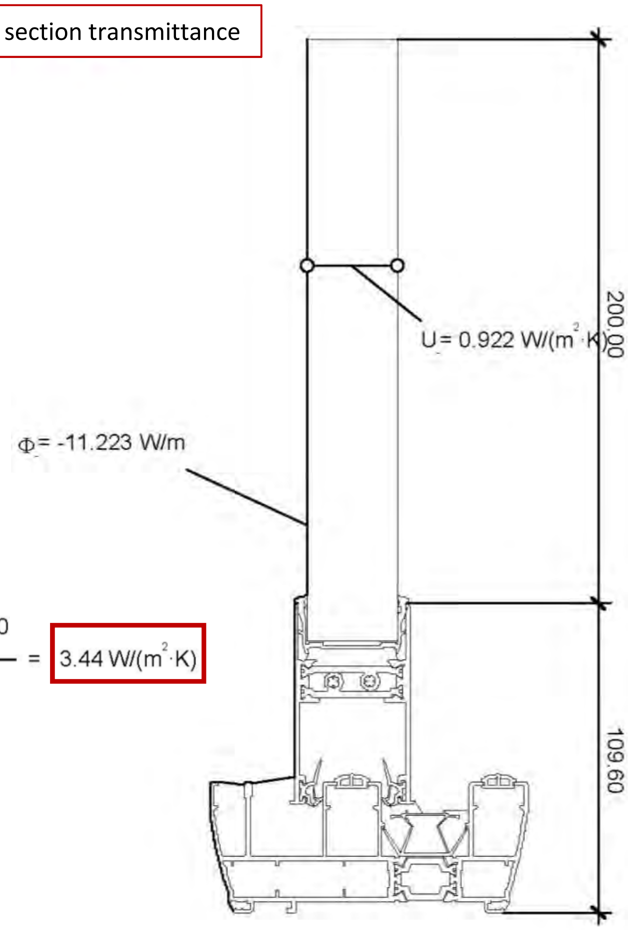


Isotherms - Temperature



Isotherms – Heat Transfer

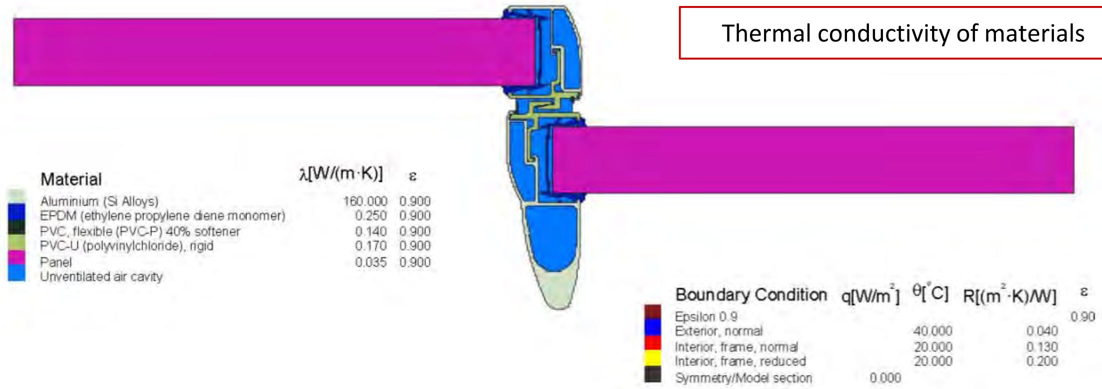
Thermal section transmittance



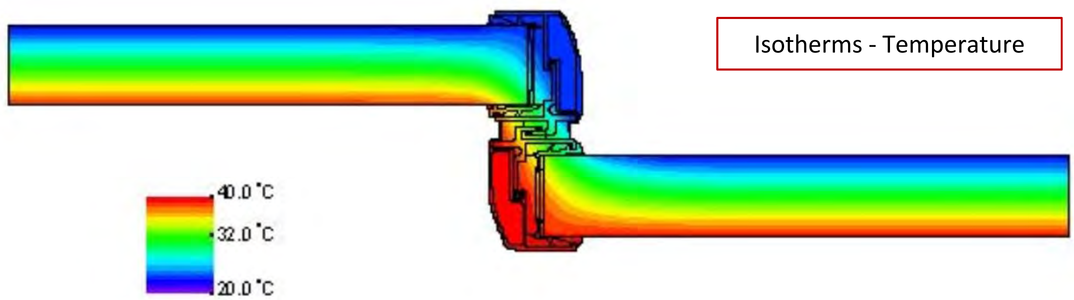
$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.223}{20.000} - 0.922 \cdot 0.200}{0.110} = \boxed{3.44\ W/(m^2 \cdot K)}$$

4.7.6 Calculation of Thermal Transmittance of Section 05

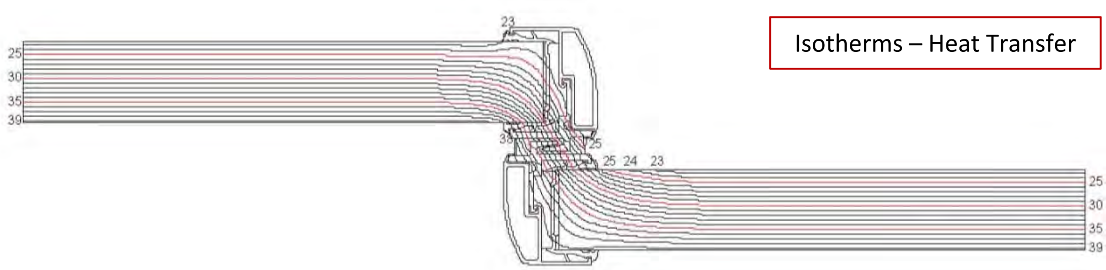
Thermal conductivity of materials

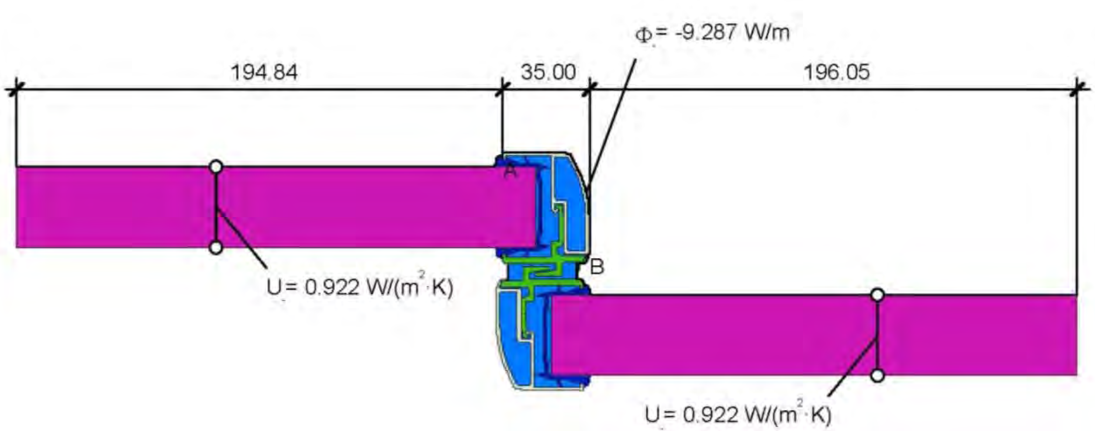


Isotherms - Temperature



Isotherms – Heat Transfer





$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{9.287}{20.000} - 0.922 \cdot 0.195 - 0.922 \cdot 0.196}{0.035} = 2.97 \ \mathrm{W/(m^2 \cdot K)}$$

Thermal section transmittance

Thermal transmittance of curtain wall

REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
CW 21	FAMILY LIVING	2680	7180	1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

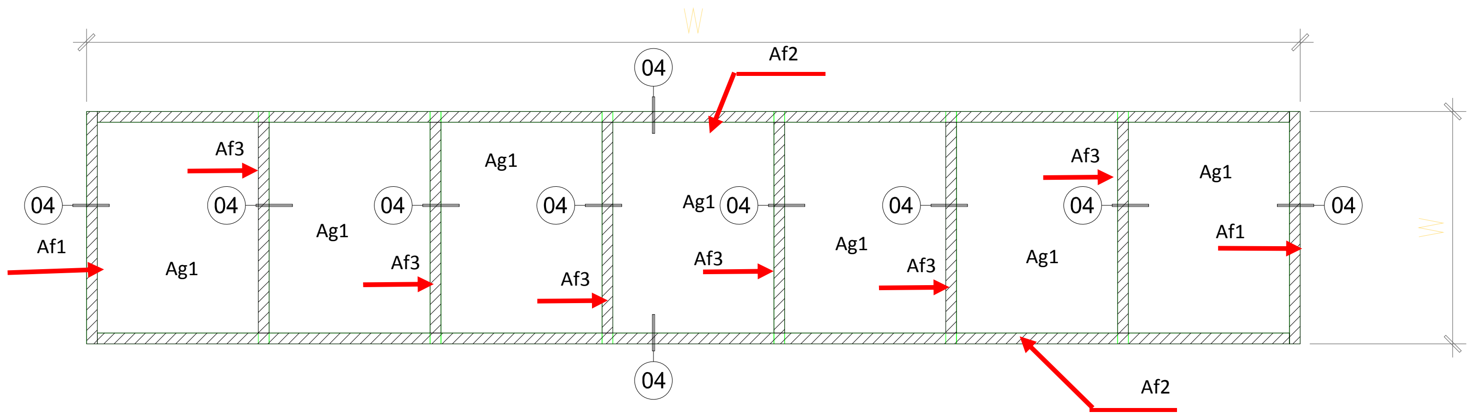
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

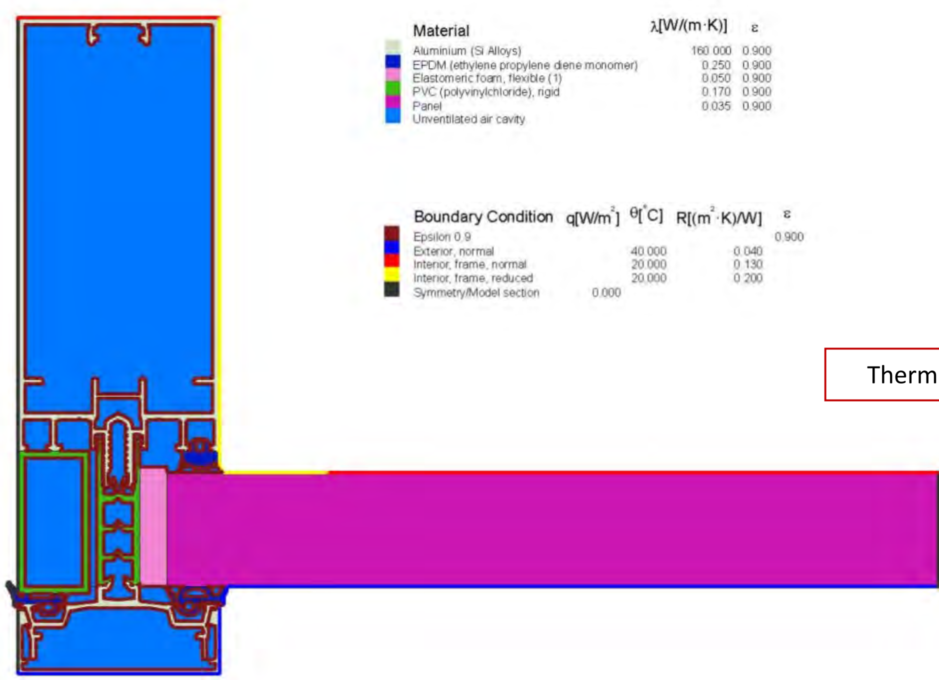
Dimension	Width	in[m]	2.680		Total window Area	in [m²]	19.242
	Height	in[m]	7.180				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	2.465
	Total Frame Area	in [m²]	0.617		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	9.860
Frame area Af1b	Exposed surface	in[m]	0.173	Glass area Ag2	Surface / unit	in [m²]	0.671
	Total Frame Area	in [m²]	0.570		Quantity		3.000
	Thermal Transmittance	in [W/m²K]	3.950		Total Surface	in [m²]	2.012
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	59.160
	Total Frame Area	in [m²]	0.190		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	59.160
Frame area Af2b	Exposed surface	in[m]	0.110	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	7.780
	Total Frame Area	in [m²]	0.160		Quantity		5.000
	Thermal Transmittance	in [W/m²K]	3.440		Toal Perimeter	in [m]	38.900
Frame area Af3	Exposed surface	in[m]	0.173	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.822				
	Thermal Transmittance	in [W/m²K]	3.950			in [W/m²K]	1.200
Frame area Af3b	Exposed surface	in[m]	0.035	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.115				
	Thermal Transmittance	in [W/m²K]	2.970			in [W/mK]	0.050
Frame area Af4	Exposed surface	in[m]	0.056	Glass area Ag3	Surface / unit	in [m²]	2.142
	Total Frame Area	in [m²]	0.613		Quantity		2.000
	Thermal Transmittance	in [W/m²K]	1.470		Total Surface	in [m²]	4.284
Total Frame Area		in [m²]	3.086	Total Glass Area		in [m²]	16.156
S Af*Uf =	9.050	in [W/m²K]					
S Ag*Ug =	14.247	in [W/m²K]					
S Af*Uf =	4.903	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.466**

4.8 CURTAIN WALL - SKYLIGHT

L - SKYLIGHT				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW08	ROOF	6280	1200	1
TOTAL				1

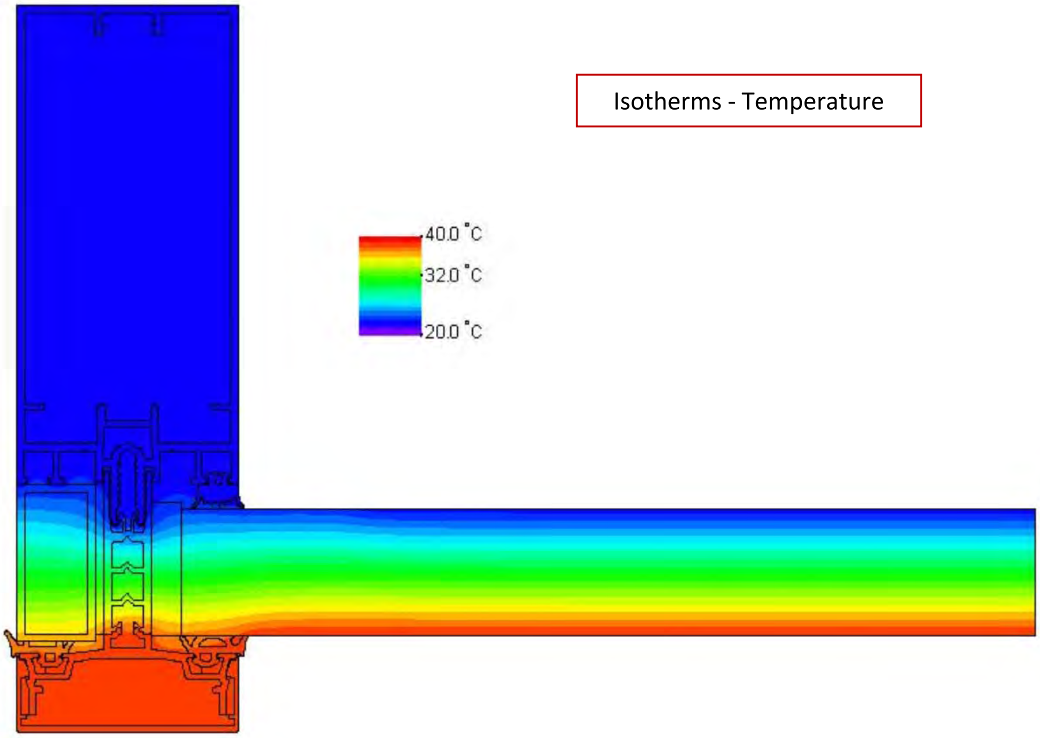


4.8.1 Calculation of Thermal Transmittance of Section 07

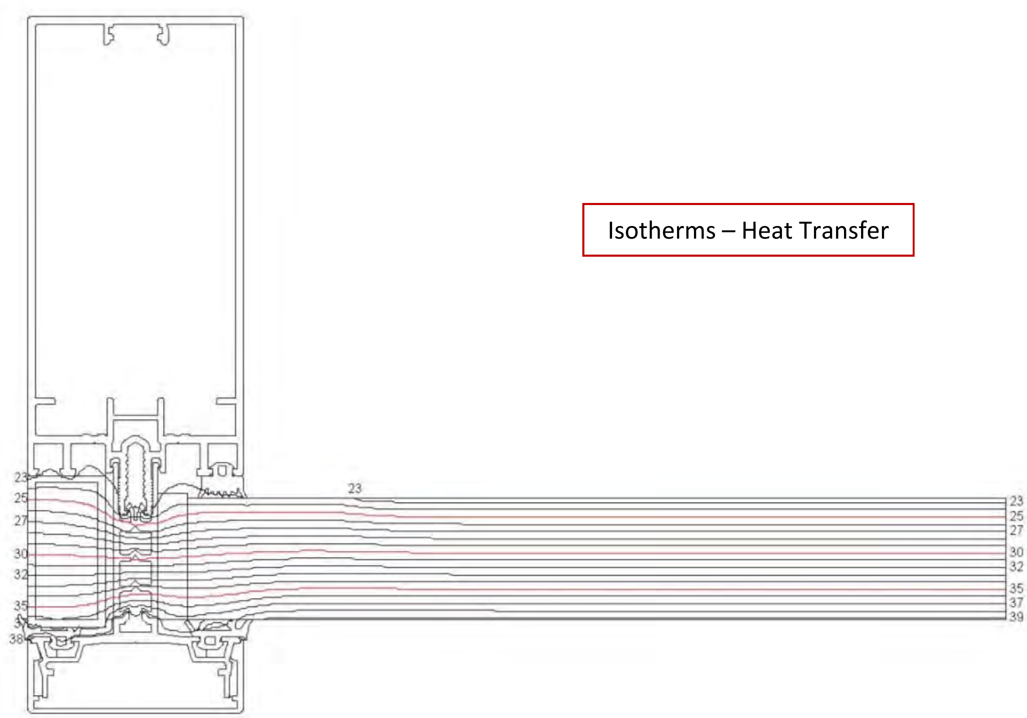


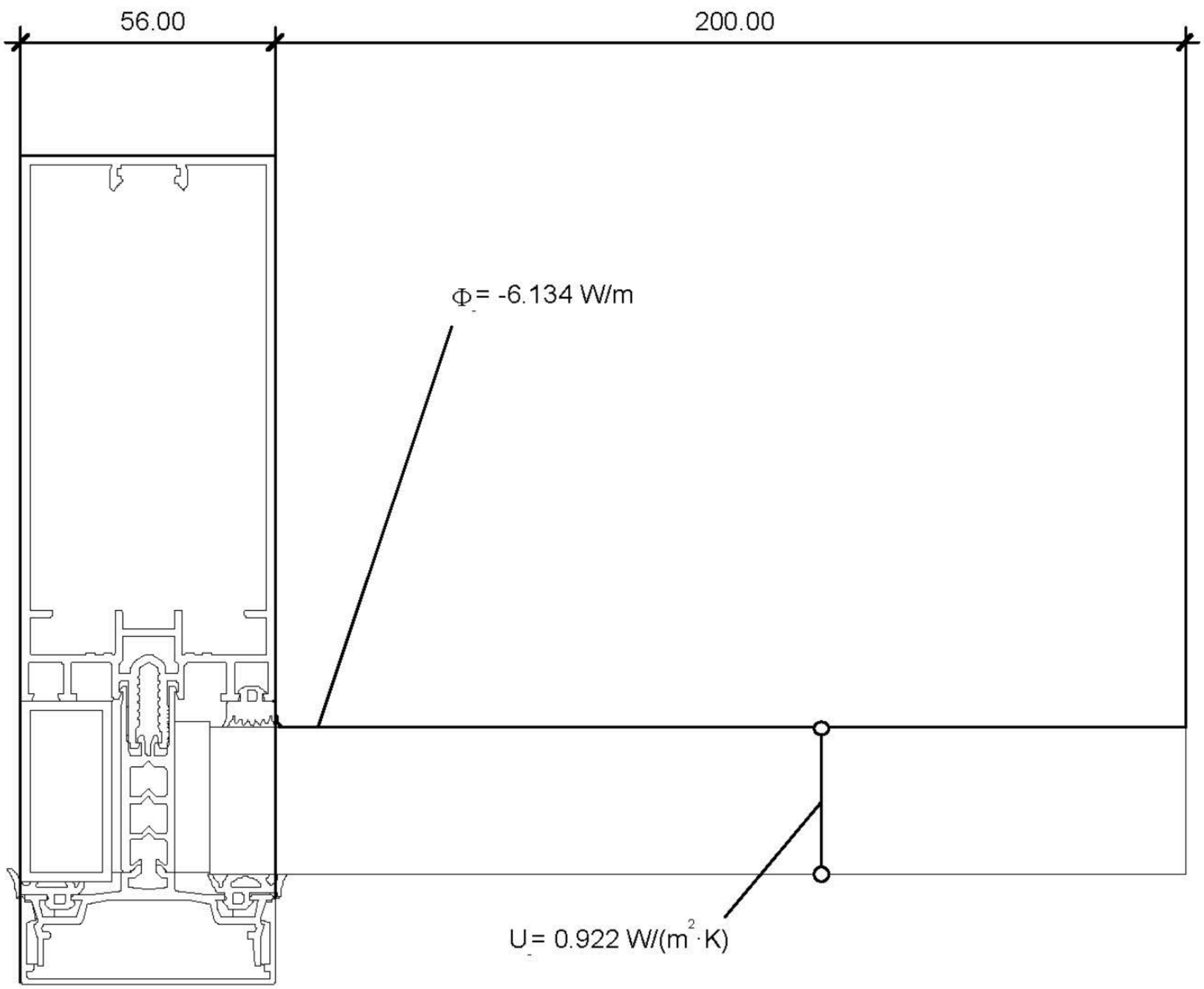
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer

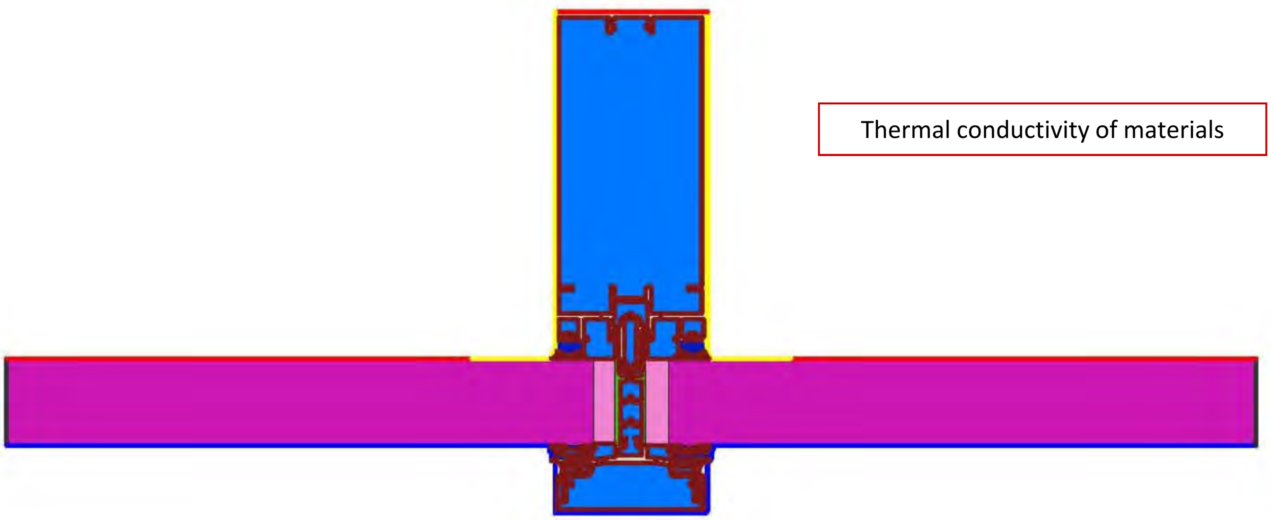




Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

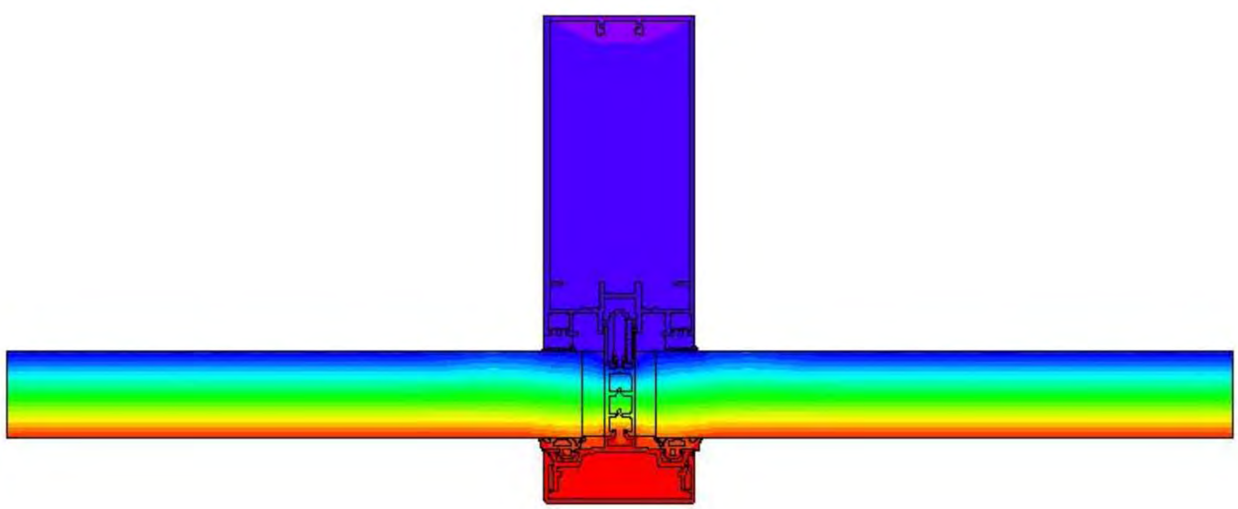
4.8.2 Calculation of Thermal Transmittance of Section 08

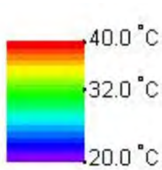


Thermal conductivity of materials

Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

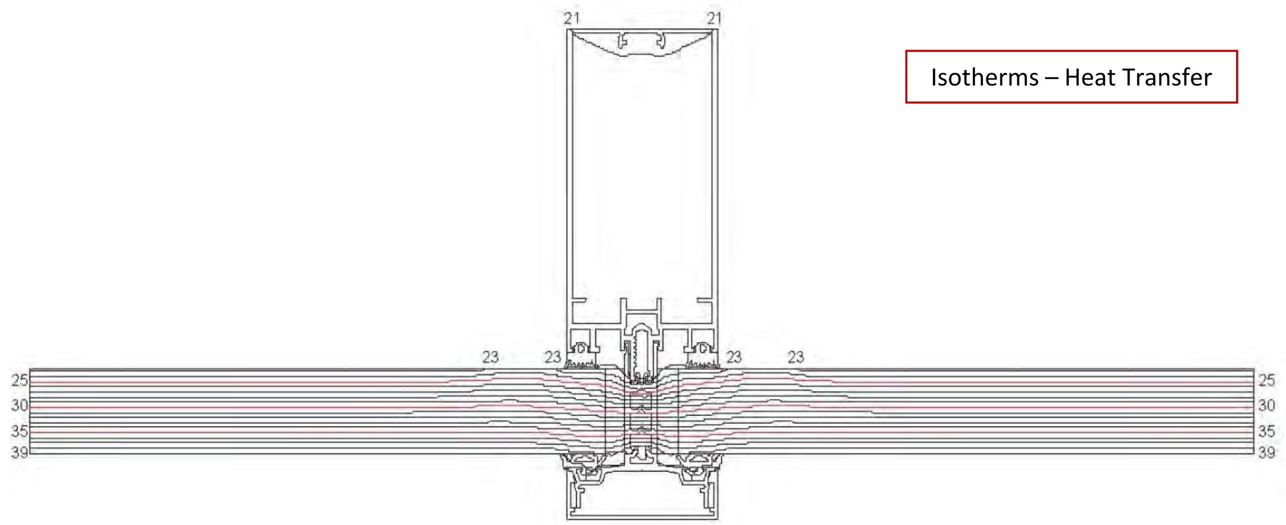
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



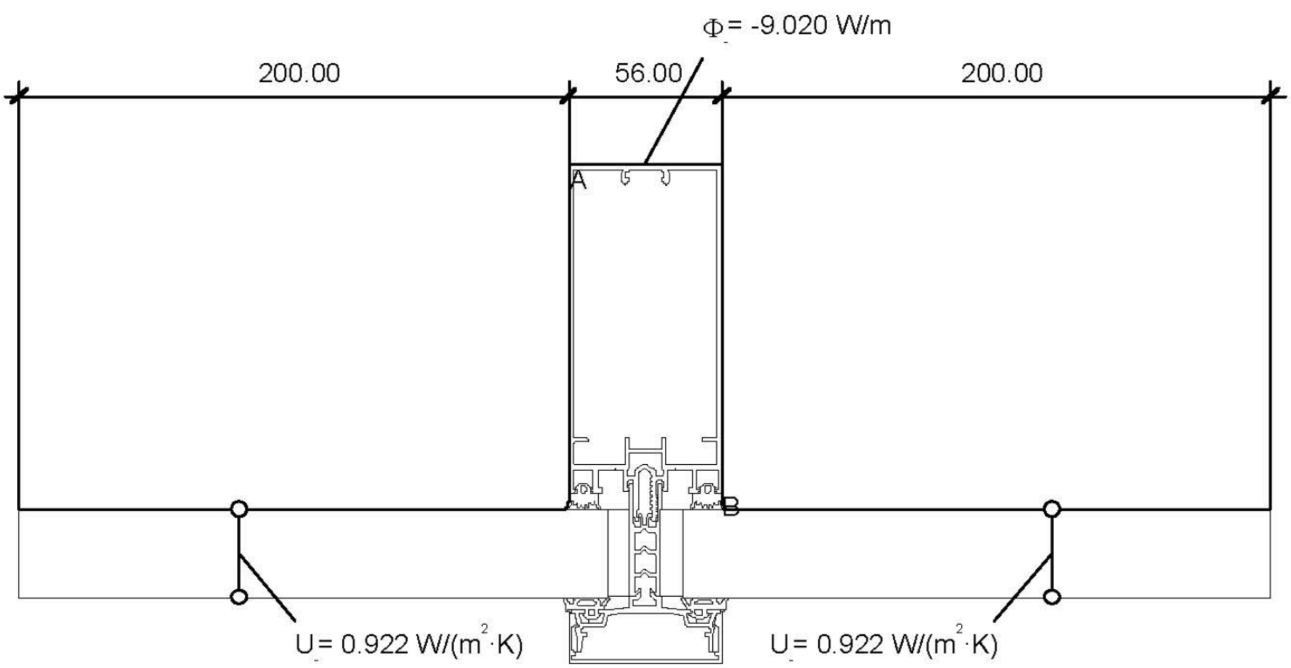


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\frac{9.020}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.056} = \boxed{1.47\ \mathrm{W/(m^2\cdot K)}}$$

Thermal transmittance of curtain wall - SKYLIGHT

L - CURTAIN WALL SKYLIGHT				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW 08	ROOF	6280	1200	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

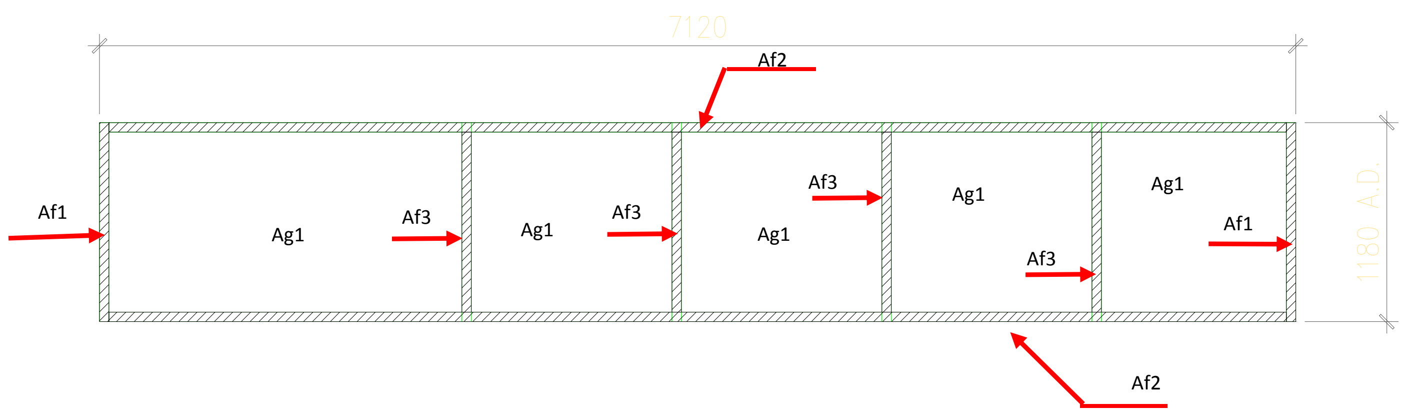
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

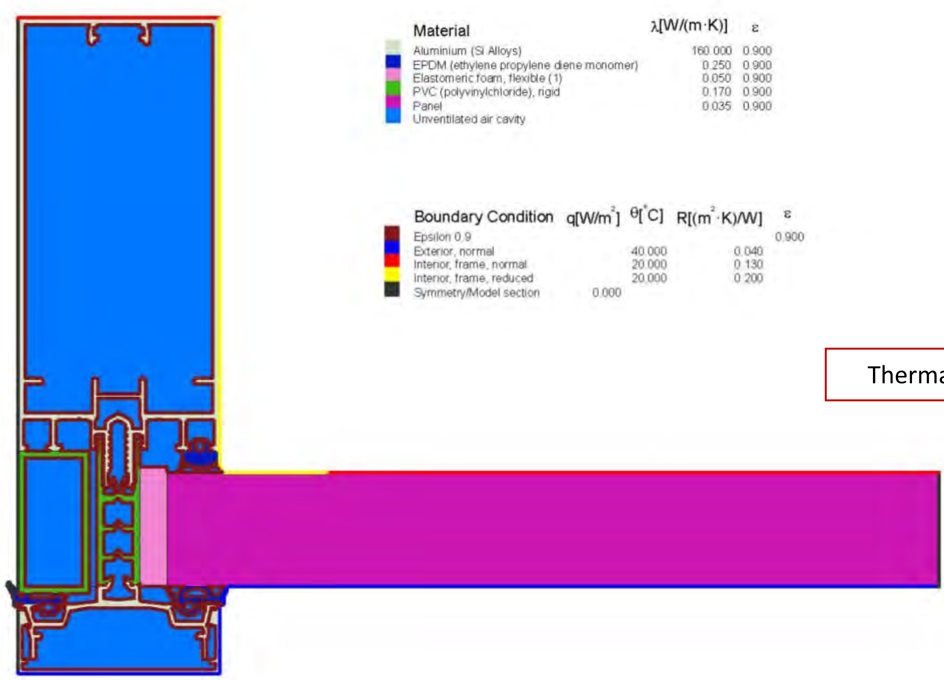
Dimension	Width	in[m]	6.280		Total window Area	in [m²]	7.536
	Height	in[m]	1.200				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	0.905
	Total Frame Area	in [m²]	0.134		Quantity		7.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	6.332
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	3.842
	Total Frame Area	in [m²]	0.703		Quantity		7.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	26.894
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.056	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.366				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	1.203	Total Glass Area		in [m²]	6.332
S Af*Uf =	2.364	in [W/m²K]					
S Ag*Ug =	7.599	in [W/m²K]					
S Af*Uf =	1.3447	in [W/m²K]		Thermal Transmittance of window (Uw)		in [W/m²K]	1.500

4.8 CURTAIN WALL - SKYLIGHT

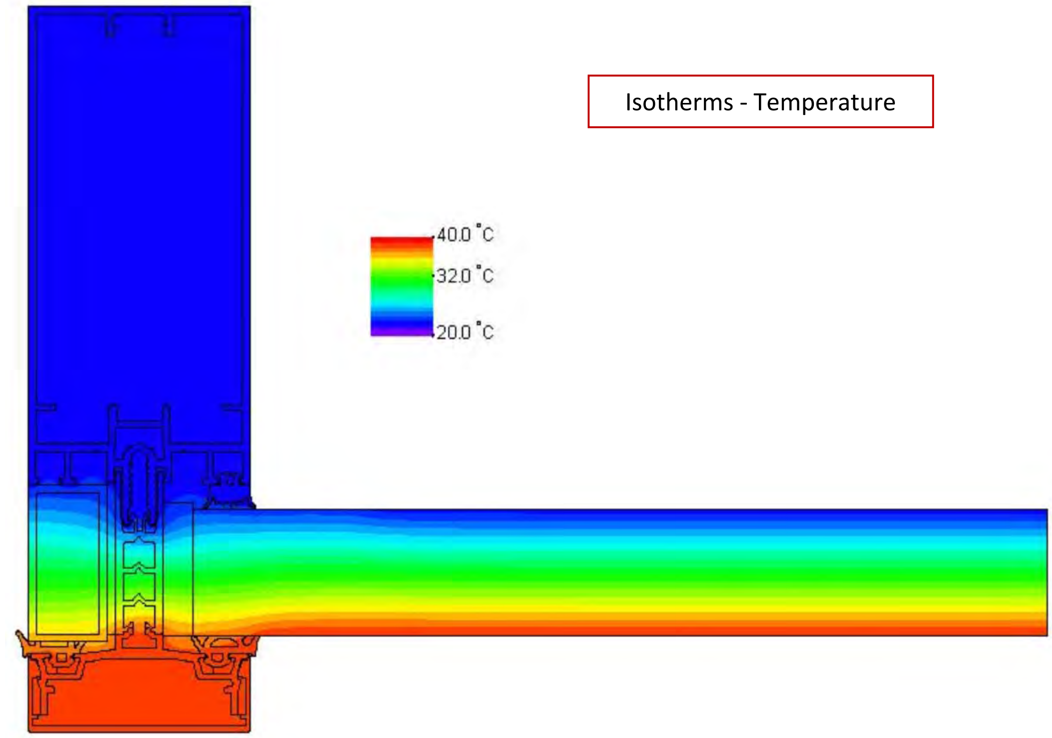
L - SKYLIGHT				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW08	ROOF	7120	1180	1
TOTAL				1



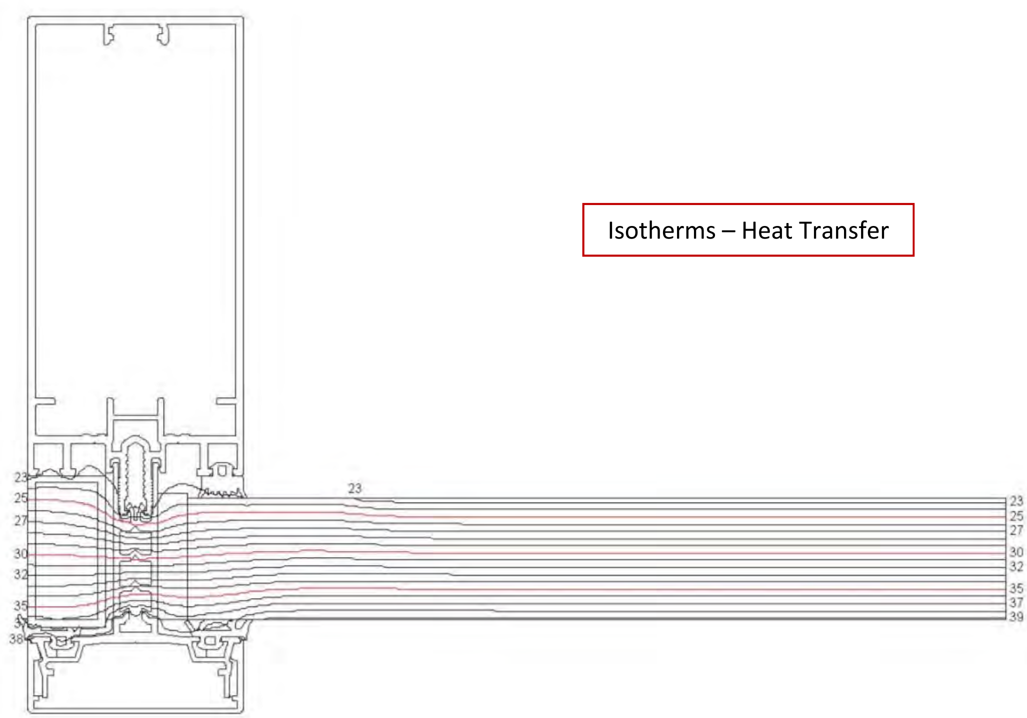
4.8.1 Calculation of Thermal Transmittance of Section 07



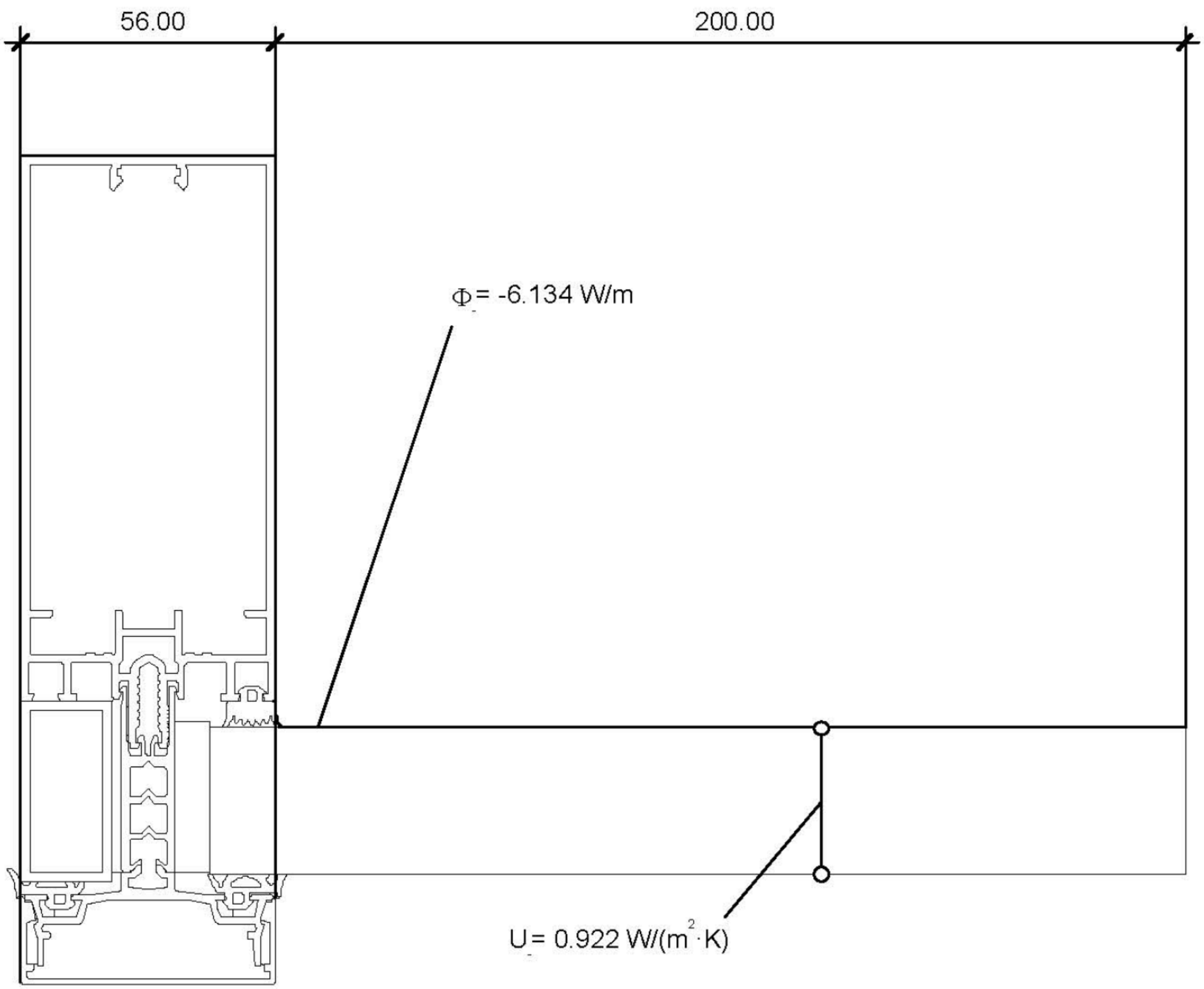
Thermal conductivity of materials



Isotherms - Temperature



Isotherms – Heat Transfer

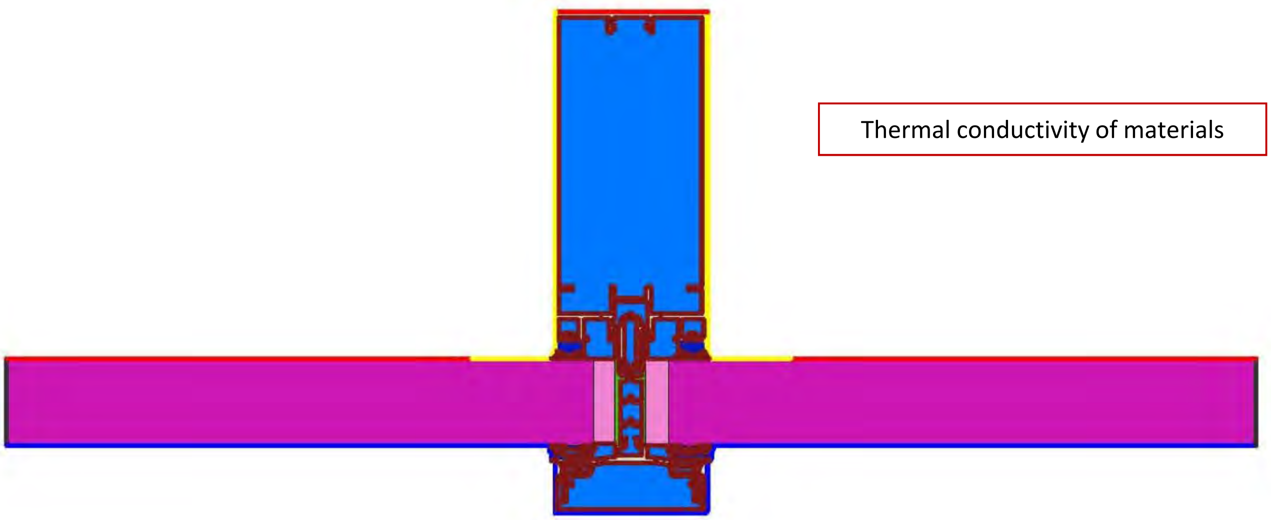


Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ \mathrm{W/(m^2 \cdot K)}}$$

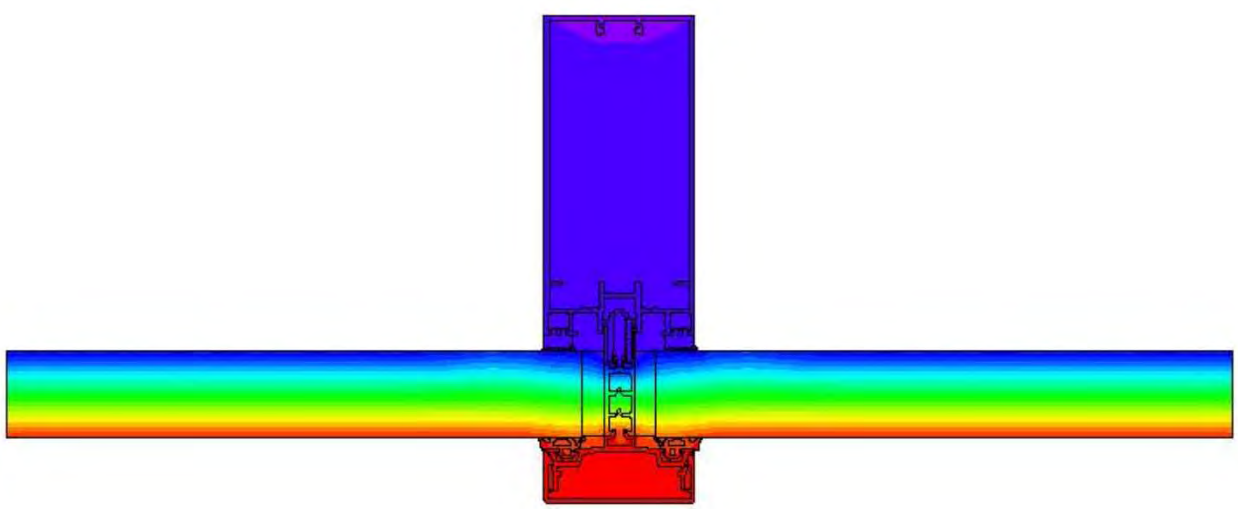
4.8.2 Calculation of Thermal Transmittance of Section 08

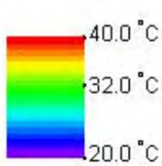
Thermal conductivity of materials



Material	λ[W/(m·K)]	ε
Aluminium (Si Alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Elastomeric foam, flexible (1)	0.050	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Unventilated air cavity		

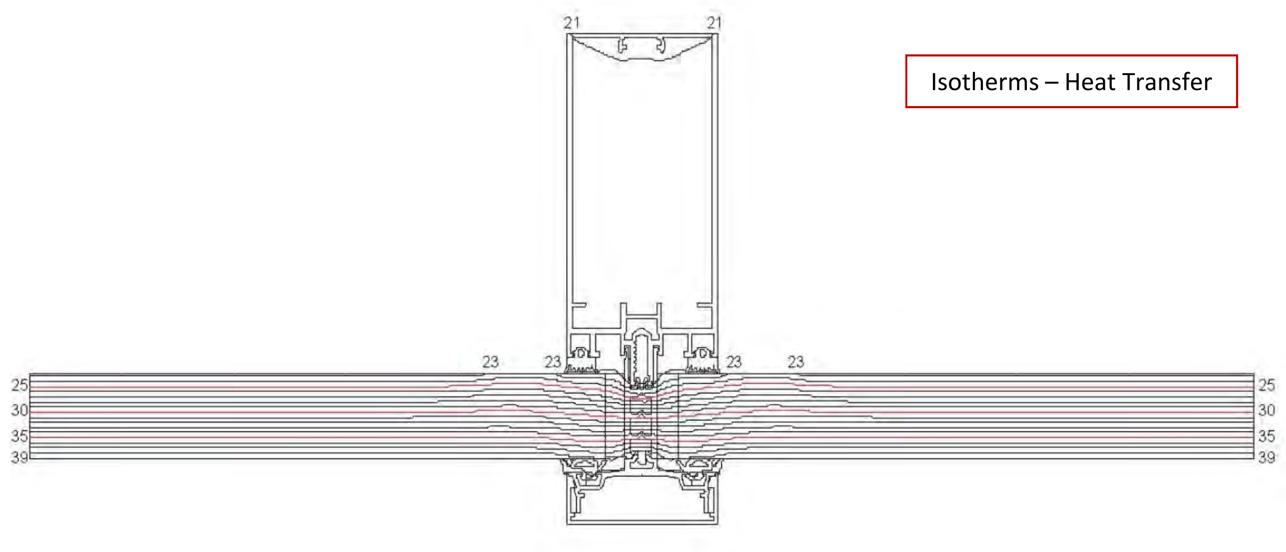
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, normal		40.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			



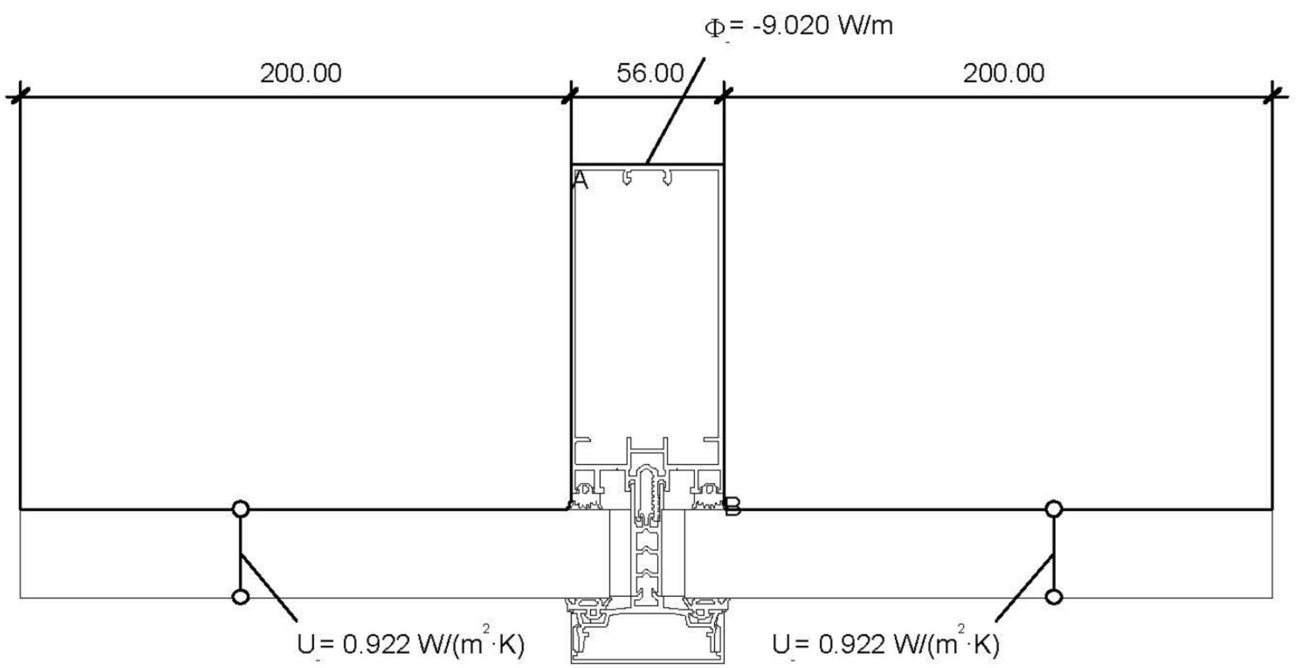


Isotherms - Temperature

Isotherms – Heat Transfer



Thermal section transmittance



$$U_{fA,B} = \frac{\dfrac{\Phi}{\Delta T} - U_{p1}\cdot b_{p1} - U_{p2}\cdot b_{p2}}{b_f} = \frac{\dfrac{9.020}{20.000} - 0.922\cdot 0.200 - 0.922\cdot 0.200}{0.056} = \boxed{1.47\ \mathrm{W/(m^2\cdot K)}}$$

Thermal transmittance of curtain wall - SKYLIGHT

L - CURTAIN WALL SKYLIGHT				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW 08	ROOF	7120	1180	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

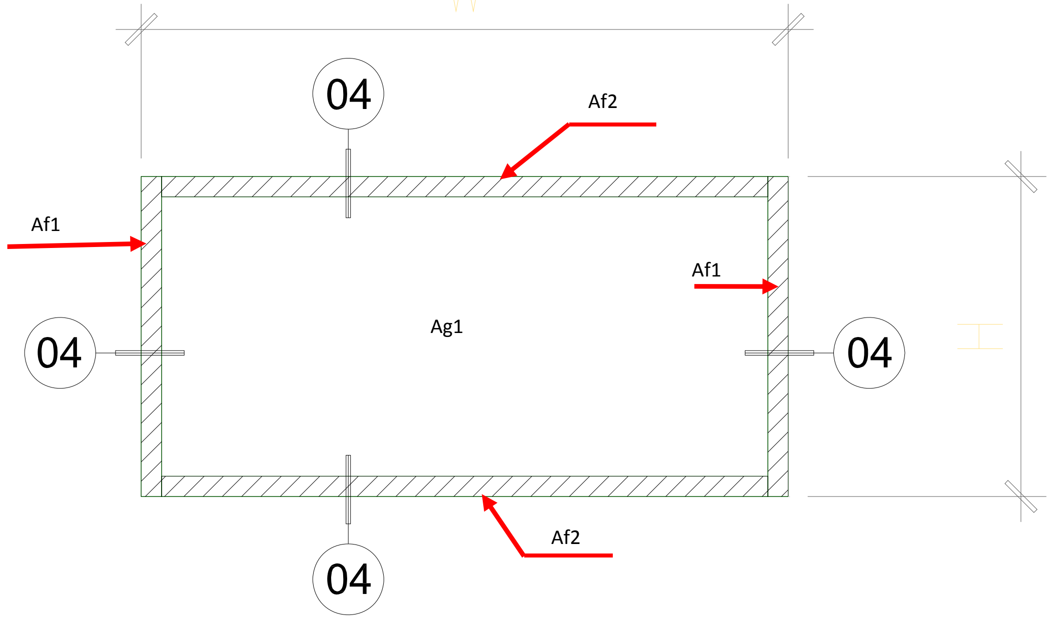
$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

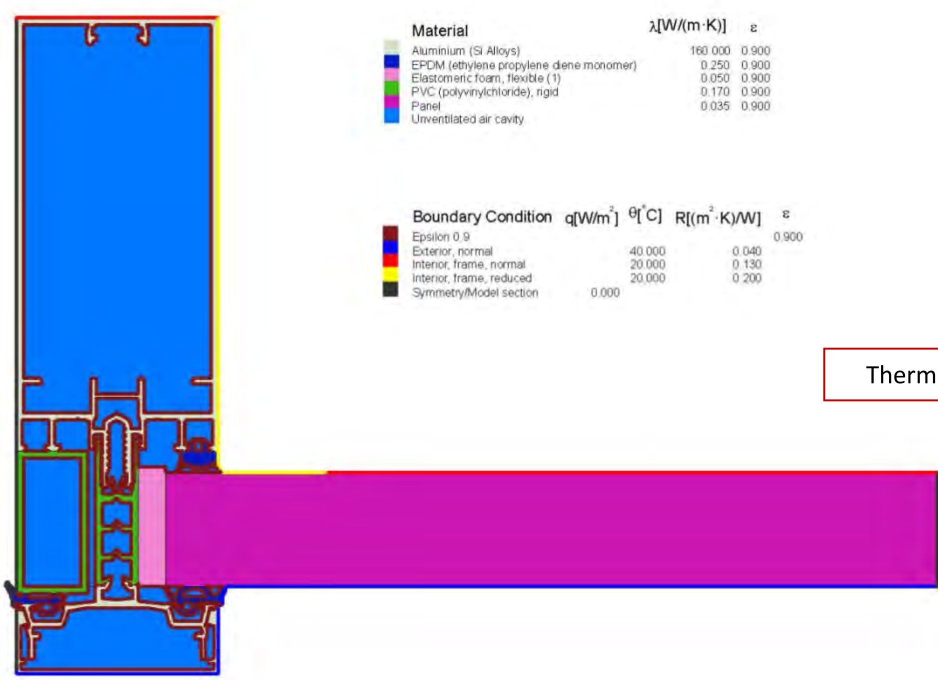
Dimension	Width	in[m]	7.120		Total window Area	in [m²]	8.402
	Height	in[m]	1.180				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	1.250
	Total Frame Area	in [m²]	0.132		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	5.000
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	2.233
	Total Frame Area	in [m²]	0.000		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	2.233
							0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	4.660
	Total Frame Area	in [m²]	0.797		Quantity		4.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	18.640
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	6.590
	Total Frame Area	in [m²]	0.000		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	6.590
Frame area Af3	Exposed surface	in[m]	0.056	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.239				
	Thermal Transmittance	in [W/m²K]	1.470			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	1.169	Total Glass Area		in [m²]	7.233
S Af*Uf =	2.378	in [W/m²K]					
S Ag*Ug =	8.679	in [W/m²K]					
S Af*Uf =	1.2615	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.466**

4.7 CURTAIN WALL – SKYLIGHT

E-CURTAIN WALL - SKYLIGHT				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW07	ROOF	2880	1340	1
GW06	ROOF	1780	880	2
TOTAL				3

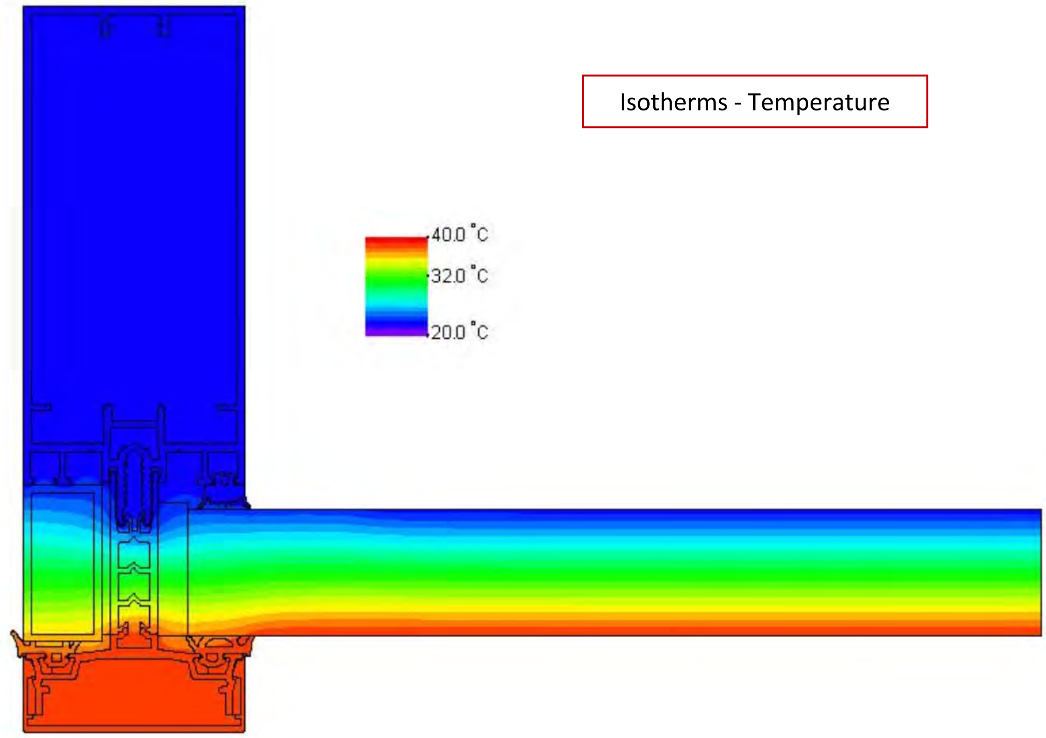


4.6.1 Calculation of Thermal Transmittance of Section 07

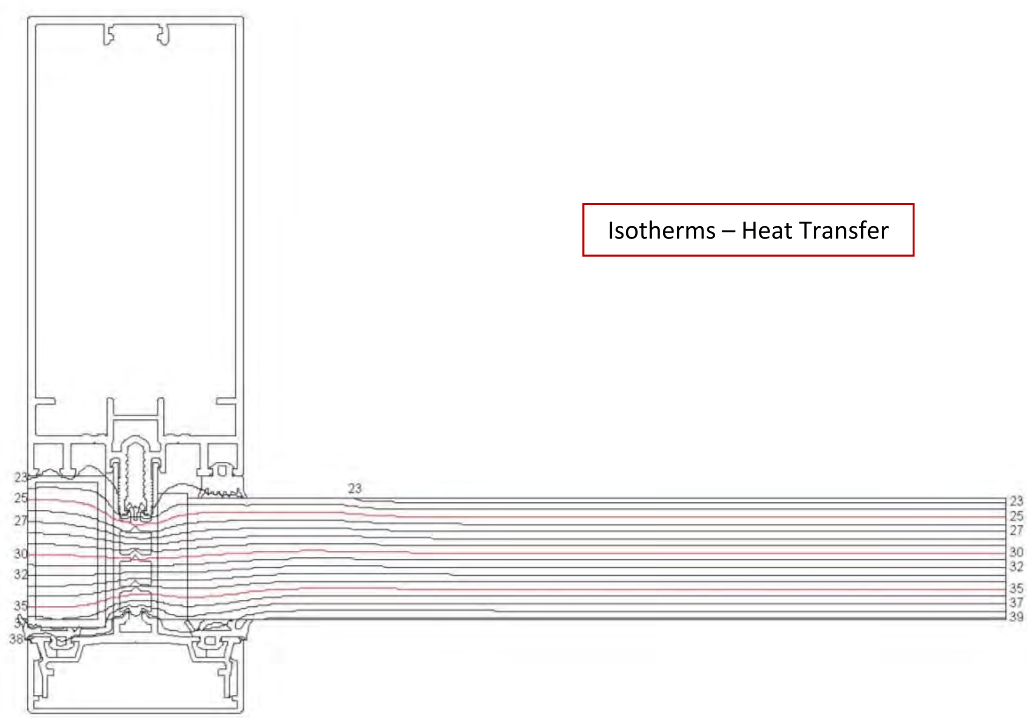


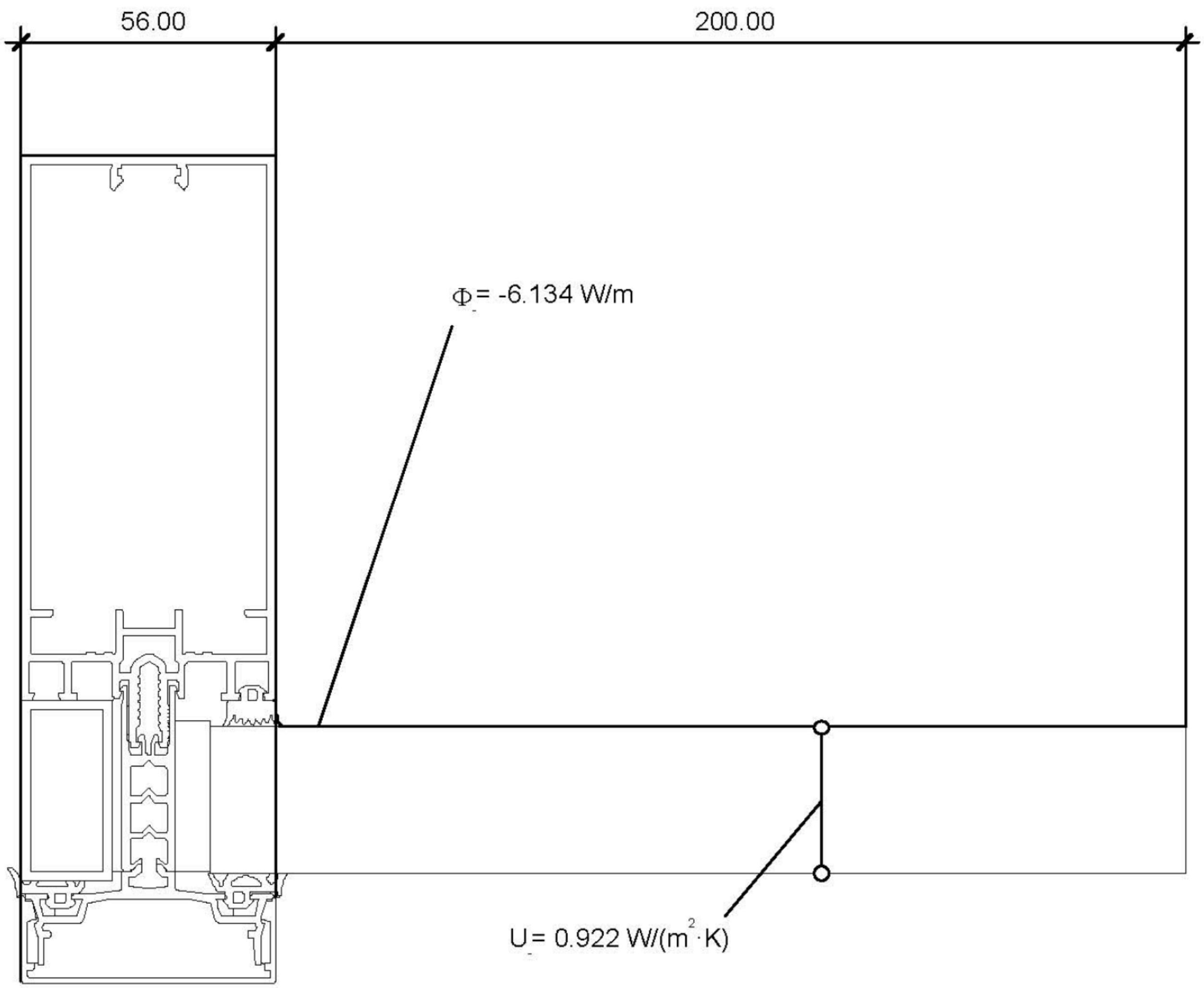
Thermal conductivity of materials

Isotherms - Temperature



Isotherms – Heat Transfer





Thermal section transmittance

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.134}{20.000} - 0.922 \cdot 0.200}{0.056} = \boxed{2.18\ W/(m^2 \cdot K)}$$

Thermal transmittance of curtain wall - skylight

E-CURTAIN WALL WITH 4 FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW07	ROOF	2880	1340	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	2.880		Total window Area	in [m^2]	3.859
	Height	in[m]	1.340				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m^2]	3.344
	Total Frame Area	in [m^2]	0.150		Quantity		1.000
	Thermal Transmittance	in [W/m^{2}K]	2.180		Total Surface	in [m^2]	3.399
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m^2]	0.000
	Total Frame Area	in [m^2]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m^{2}K]	0.000		Total Surface	in [m^2]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	7.992
	Total Frame Area	in [m^2]	0.310		Quantity		1.000
	Thermal Transmittance	in [W/m^{2}K]	2.180		Toal Perimeter	in [m]	7.992
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m^2]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m^{2}K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.000	Glass Thermal Transmittance			
	Total Frame Area	in [m^2]	0.000				
	Thermal Transmittance	in [W/m^{2}K]	0.000			in [W/m^{2}K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			S
	Total Frame Area	in [m^2]	0.000				
	Thermal Transmittance	in [W/m^{2}K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m^2]	0.460	Total Glass Area		in [m^2]	3.399
S Af*Uf =	1.003	in [W/m^{2}K]					
S Ag*Ug =	4.079	in [W/m^{2}K]					
S Af*Uf =	0.3996	in [W/m^{2}K]		**Thermal Transmittance of window (Uw)**		**in [W/m^{2}K]**	**1.420**

Thermal transmittance of curtain wall - skylight

E-CURTAIN WALL WITH 4 FIXED				
REF.	LOCATION	WIDTH (in mm)	HEIGHT (in mm)	QTY
GW06	ROOF	1780	880	1
TOTAL				1

According to the frames elevations and sections above mentioned.
According to ISO 10077-1:2006, thermal transmittance of a single window, U_w, shall be calculated using Equation:

$$U_w = \frac{\sum A_g U_g + \sum A_f U_f + \sum l_g \Psi_g}{\sum A_g + \sum A_f}$$

Result :

Dimension	Width	in[m]	1.780		Total window Area	in [m²]	1.566
	Height	in[m]	0.880				
Aluminium Frame				Glass Area			
Description		Unit	Value	Description		Unit	Value
Frame area Af1	Exposed surface	in[m]	0.056	Glass area Ag1	Surface / unit	in [m²]	1.226
	Total Frame Area	in [m²]	0.099		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Total Surface	in [m²]	1.281
Frame area Af1b	Exposed surface	in[m]	0.000	Glass area Ag2	Surface / unit	in [m²]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Total Surface	in [m²]	0.000
Frame area Af2	Exposed surface	in[m]	0.056	Perimeter Glass Area Ag1	Perimeter/Unit	in[m]	4.872
	Total Frame Area	in [m²]	0.187		Quantity		1.000
	Thermal Transmittance	in [W/m²K]	2.180		Toal Perimeter	in [m]	4.872
Frame area Af2b	Exposed surface	in[m]	0.000	Perimeter Glass Area Ag2	Perimeter/Unit	in[m]	0.000
	Total Frame Area	in [m²]	0.000		Quantity		0.000
	Thermal Transmittance	in [W/m²K]	0.000		Toal Perimeter	in [m]	0.000
Frame area Af3	Exposed surface	in[m]	0.000	Glass Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/m²K]	1.200
Frame area Af4	Exposed surface	in[m]	0.000	Linear Thermal Transmittance			
	Total Frame Area	in [m²]	0.000				
	Thermal Transmittance	in [W/m²K]	0.000			in [W/mK]	0.050
Total Frame Area		in [m²]	0.285	Total Glass Area		in [m²]	1.281
S Af*Uf =	0.622	in [W/m²K]					
S Ag*Ug =	1.537	in [W/m²K]					
S Af*Uf =	0.2436	in [W/m²K]		**Thermal Transmittance of window (Uw)**		**in [W/m²K]**	**1.534**

WHOLE THERMAL TRANSMITTANCE OF VILLA TYPE 4

According to single windows thermal transmittal, the average whole thermal transmittal of windows for Villa Type 08 shall be calculated by the following Equation:.

$$U_w = \frac{\sum AwUw}{\sum Aw}$$

Result :

REFRENCE	Width	Height	Area Aw	QTY	Total Area	Glass Thermal Transmittance	Window Thermal Transmittance Uw	Saw*Uw
	in [m]	in [m]	in [m²]		in [m²]	in [W/m²K]	in [W/m²K]	in [W/K]
CW17	1.73	2.99	5.173	1	5.1727	1.2	1.749	9.047
CW16	2.69	2.99	8.043	1	8.0431	1.2	1.592	12.805
CW20	2.69	2.99	8.043	1	8.0431	1.2	1.592	12.805
CW14	3.19	2.99	9.538	1	9.5381	1.2	1.508	14.383
CW24	3.59	2.99	10.734	1	10.7341	1.2	1.508	16.187
CW03	3.59	3.29	11.8111	2	23.6222	1.2	1.486	35.103
CW13	4.49	2.99	13.4251	1	13.4251	1.2	1.433	19.238
CW15	4.07	2.99	12.1693	1	12.1693	1.2	1.445	17.585
GW03	1.59	0.59	0.9381	1	0.9381	1.2	2.276	2.135
CW23	1.78	3.9	6.942	1	6.942	1.2	1.410	9.788
CW01	2.55	6.88	17.544	1	17.544	1.2	1.366	23.965
CW22	4.42	7.18	31.7356	1	31.7356	1.2	1.383	43.890
CW04	5.385	3.28	17.6628	1	17.6628	1.2	1.378	24.339
CW11	1.48	2.98	4.4104	1	4.4104	1.2	1.408	6.210
GW01	0.59	1.79	1.0561	2	2.1122	1.2	2.404	5.078
GW04	0.59	2.39	1.4101	1	1.4101	1.2	2.317	3.267
GW04A	0.59	2.39	1.4101	1	1.4101	1.2	2.317	3.267
GW04B	0.59	2.39	1.4101	1	1.4101	1.2	2.317	3.267
GW04C	0.59	2.39	1.4101	2	2.8202	1.2	2.317	6.534
GW05	1.59	1.79	2.8461	1	2.8461	1.2	1.919	5.462
GW02	3.49	0.54	1.8846	1	1.8846	1.2	2.013	3.794
GW10	0.59	2.99	1.7641	3	5.2923	1.2	1.941	10.272
CW06	7.125	3.28	23.37	1	23.37	1.2	1.563	36.527
CW21	2.68	7.18	19.2424	1	19.2424	1.2	1.466	28.209
GW08	6.28	1.2	7.536	1	7.536	1.2	1.500	11.304
GW07	2.88	1.34	3.8592	1	3.8592	1.2	1.420	5.480
GW11	7.12	1.18	8.4016	1	8.4016	1.2	1.466	12.317
GW06	1.78	0.88	1.5664	1	1.5664	1.2	1.534	2.403
Total					253.1419			380.8153
					U value for Whole Villa Type 04			**1.504**

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THERMAL CALCULATION NOTE
For Villa Type 4

APPENDIX A

GLAZING DATA

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THERMAL CALCULATION NOTE

For Villa Type 4

APPENDIX B

SHOP DRAWINGS
