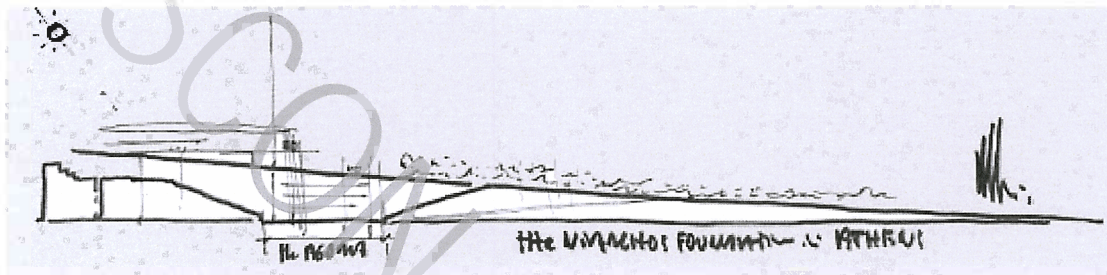


Project: Stavros Niarchos Foundation Cultural Center
Date: 1/10/2015
Simulation Software: Frame Simulator 3
File Name: Uw Report SNFCC Skylights.doc

Title: Uw Report for SNFCC Skylights FT-07
Project: Stavros Niarchos Foundation Cultural Center
Location: Piraeus, Greece



Project: Stavros Niarchos Foundation Cultural Center
Date: 1/10/2015
Simulation Software: Frame Simulator 3
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2. Design Standards and Norms
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7. Dimensioned Drawing for Glass Panel
8. Ug Results and Material List for Glazing
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Project: Stavros Niarchos Foundation Cultural Center
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1. Technical Description

The scope of this report is to evaluate and assess the thermal transmittance value (U-factor) of the "Skylights FT-07" for the project Stavros Niarchos Foundation Cultural Center (SNFCC) in Piraeus, Greece. The skylights are designed in two (2) buildings of the Center: The Opera Building (Drawings 10-5-8881 and 10-5-8882) and the Library Building (Drawing 20-5-8881). The skylights have double glazing panels; the external panel is a fully tempered panel of 8mm, an air space of 12mm and an internal heat strengthened laminated panel of 2x8mm thickness. The internal panel has a Low-E membrane on surface #3 with an emissivity value of less than or equal to 0.041. The software that is used to simulate the thermal transmittance values is Frame Simulator 3.

Note: For all of the thermal transmittance simulations the screw effect has been calculated in accordance to EN ISO 12631:2012. The values using the finite element method may deviate +/- 0,15 W/m²K from a hot-box test.

2. Design Standards and Norms

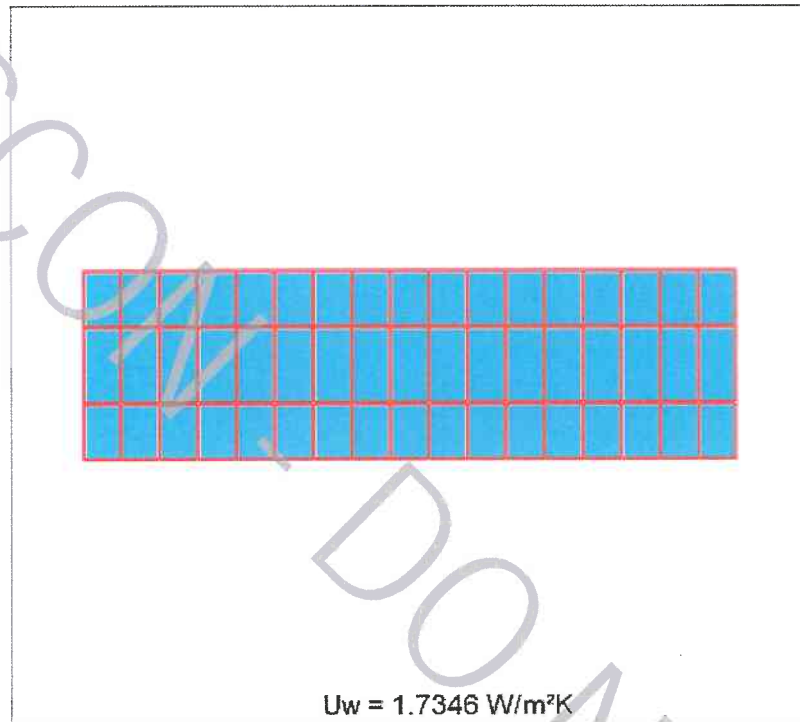
EN ISO 10077-1:2012	Thermal performance of windows, doors and shutters -- Calculation of thermal transmittance -- Part 1: General
EN ISO 10077-2:2012	Thermal performance of windows, doors and shutters -- Calculation of thermal transmittance -- Part 2: Numerical method for frames
EN ISO 12631:2012	Thermal performance of curtain walling -- Calculation of thermal transmittance



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3. Uw Results for Skylights

3.1 Library Skylight



Library Skylight
 Width 21312.81 mm
 Height 6250.00 mm
 Transmittance (Uw) 1.7346 W/m²K

Name	U [W/m ² K]	Width [mm]	Height [mm]	A [m ²]	Col.
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075	



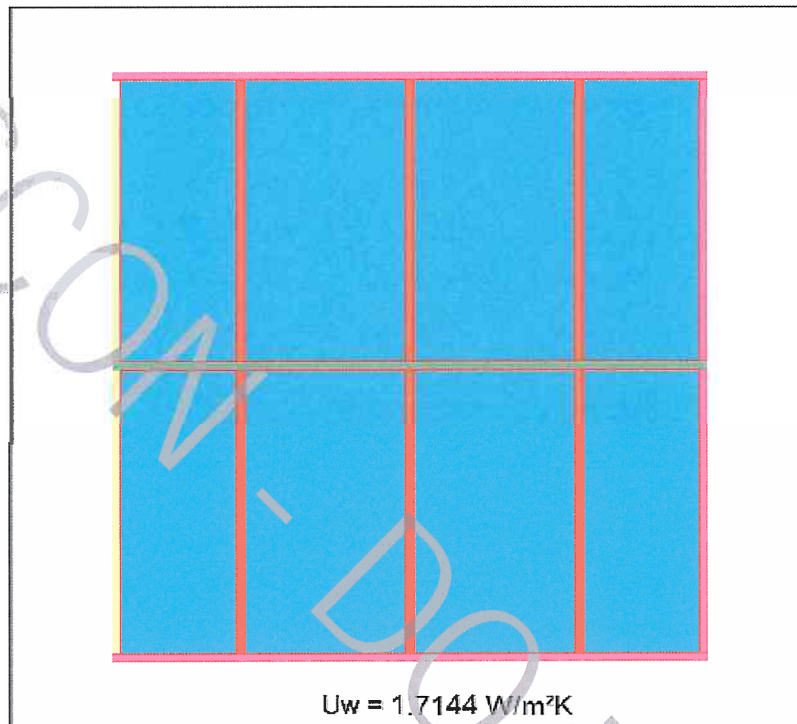
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Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1163.69	1785.00	2.07720
Glass 8/12/8.8	1.5800	1163.69	2440.00	2.83942
Glass 8/12/8.8	1.5800	1163.69	1785.00	2.07720
Glass 8/12/8.8	1.5800	1193.69	2440.00	2.91262
Glass 8/12/8.8	1.5800	1163.69	2440.00	2.83942
Glass 8/12/8.8	1.5800	1163.69	1785.00	2.07720
Glass 8/12/8.8	1.5800	1163.69	1785.00	2.07720
Glass 8/12/8.8	1.5800	1193.69	1785.00	2.13075
Section-001	2.8500	21312.81	60.00	1.27877
Section-001	2.8500	21312.81	60.00	1.27877
Section-001	2.8500	60.00	1785.00	0.10710
Section-001	2.8500	60.00	2440.00	0.14640
Section-001	2.8500	60.00	1785.00	0.10710
Section-002	1.0840	21312.81	60.00	1.27877
Section-002	1.0840	21312.81	60.00	1.27877
Section-003	3.0900	60.00	1785.00	0.10710




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3.2 Opera Skylight (A)








Skylight Opera (A)
 Width 4401.13 mm
 Height 4400.00 mm
 Transmittance (Uw) 1.7144 W/m²K

Name	U [W/m²K]	Width [mm]	Height [mm]	A [m²]	Col.
Glass 8/12/8.8	1.5800	1190.32	2110.00	2.51158	
Glass 8/12/8.8	1.5800	1190.07	2110.00	2.51106	
Glass 8/12/8.8	1.5800	860.49	2110.00	1.81564	
Glass 8/12/8.8	1.5800	860.24	2110.00	1.81512	
Glass 8/12/8.8	1.5800	1190.07	2110.00	2.51106	
Glass 8/12/8.8	1.5800	860.49	2110.00	1.81564	
Glass 8/12/8.8	1.5800	860.24	2110.00	1.81512	
Glass 8/12/8.8	1.5800	1190.32	2110.00	2.51158	
Section-002	1.0840	4401.13	60.00	0.26407	



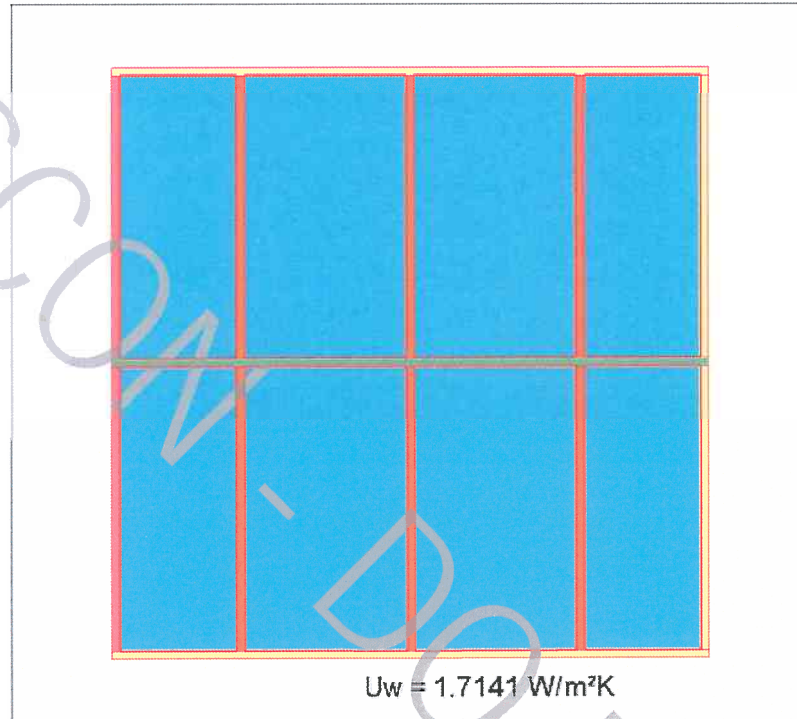
Project: Stavros Niarchos Foundation Cultural Center
 Date: 1/10/2015
 Simulation Software: Frame Simulator 3
 File Name: Uw Report SNFCC Skylights.doc

Section-005	1.7370	60.00	2110.00	0.12660	
Section-005	1.7370	60.00	2110.00	0.12660	
Section-005	1.7370	4401.13	60.00	0.26407	
Section-005	1.7370	4401.13	60.00	0.26407	
Section-006	1.2770	60.00	2110.00	0.12660	
Section-006	1.2770	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
ψ material		ψ [W/mK]	Total length [mm]	Col.	
TGI-Technoform		0.0490	50164.53		




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3.3 Opera Skylight (B)











Skylight Opera (B)
Width 4416.09 mm
Height 4400.00 mm
Transmittance (Uw) 1.7141 W/m²K

Name	U [W/m²K]	Width [mm]	Height [mm]	A [m²]	Col.
Glass 8/12/8.8	1.5800	863.72	2110.00	1.82246	
Glass 8/12/8.8	1.5800	863.47	2110.00	1.82193	
Glass 8/12/8.8	1.5800	1194.57	2110.00	2.52055	
Glass 8/12/8.8	1.5800	1194.32	2110.00	2.52002	
Glass 8/12/8.8	1.5800	1194.32	2110.00	2.52002	
Glass 8/12/8.8	1.5800	863.72	2110.00	1.82246	
Glass 8/12/8.8	1.5800	863.47	2110.00	1.82193	
Glass 8/12/8.8	1.5800	1194.57	2110.00	2.52055	
Glass 8/12/8.8	1.5800	1194.57	2110.00	2.52055	
Section-002	1.0840	4416.09	60.00	0.26497	



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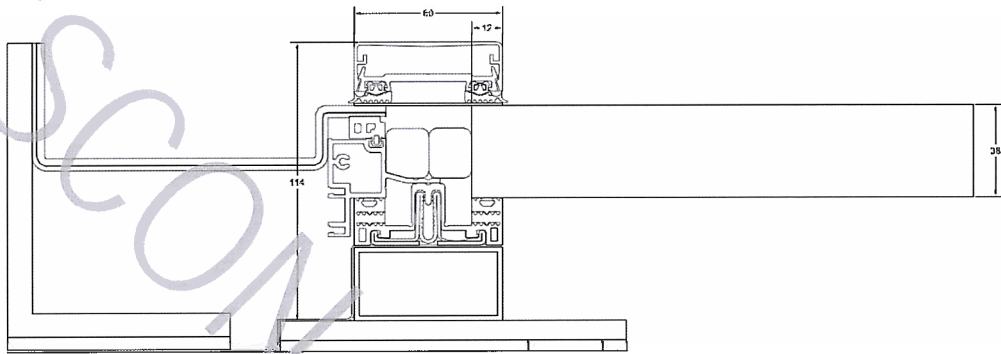
Section-005	1.7370	4416.09	60.00	0.26497	
Section-005	1.7370	4416.09	60.00	0.26497	
Section-005	1.7370	60.00	2110.00	0.12660	
Section-005	1.7370	60.00	2110.00	0.12660	
Section-006	1.2770	60.00	2110.00	0.12660	
Section-006	1.2770	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
Section-007	1.8820	60.00	2110.00	0.12660	
ψ material					
TGI Spacer	0.0490		50224.36		



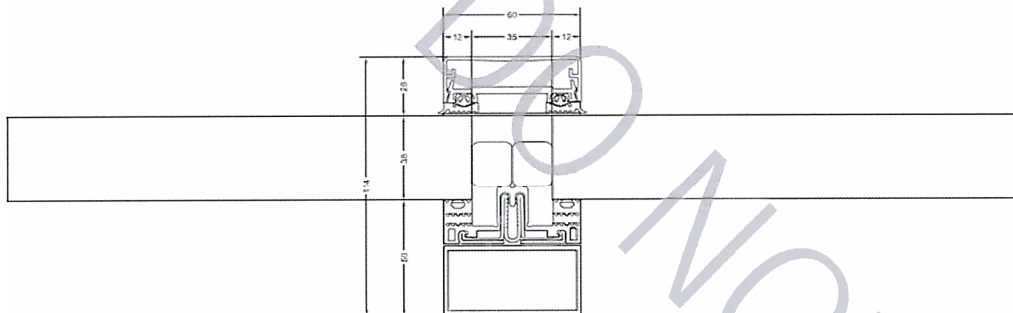
Project: Stavros Niarchos Foundation Cultural Center
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4. Dimensioned Sections

4.1 Section 001

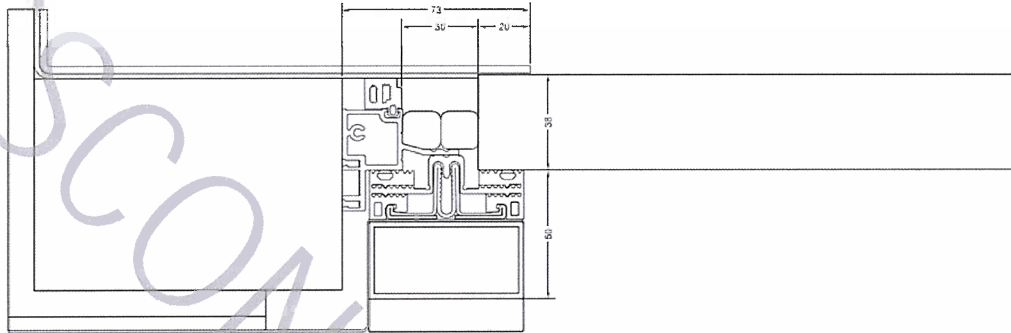


4.2 Section 002

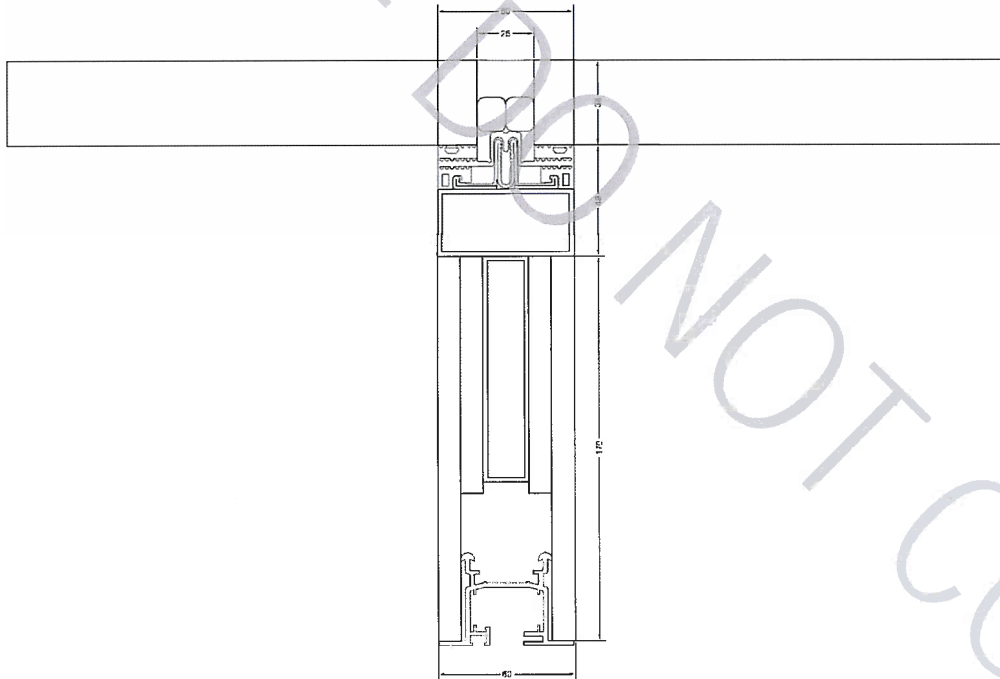


Project: Stavros Niarchos Foundation Cultural Center
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4.3 Section 003

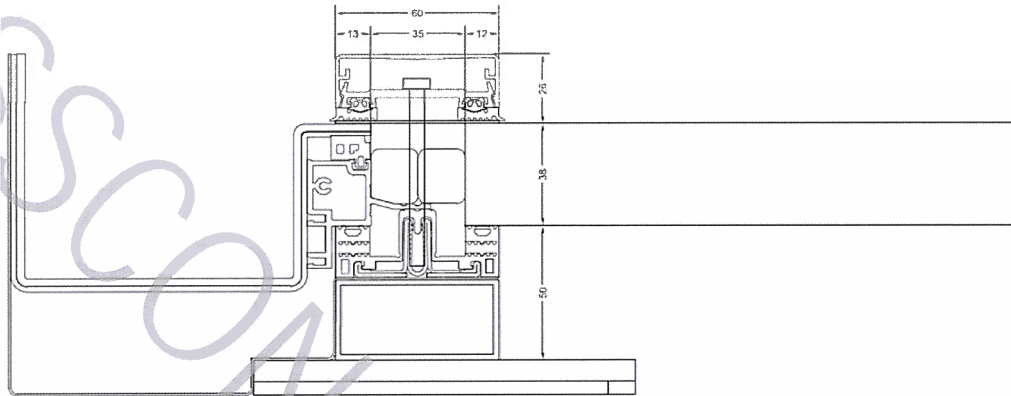


4.4 Section 004

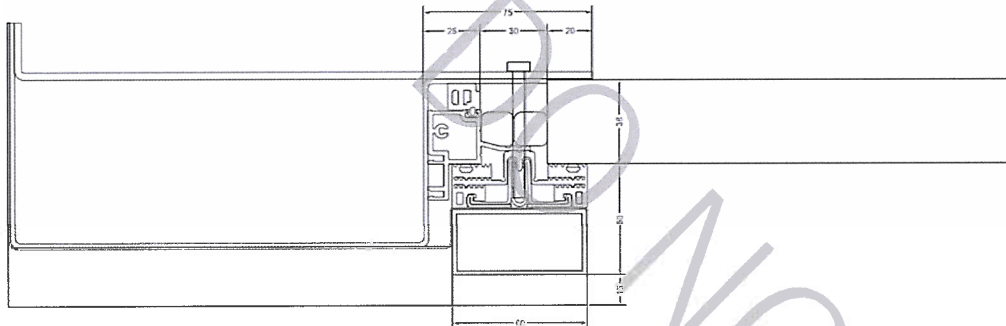


Project: Stavros Niarchos Foundation Cultural Center
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4.5 Section 005

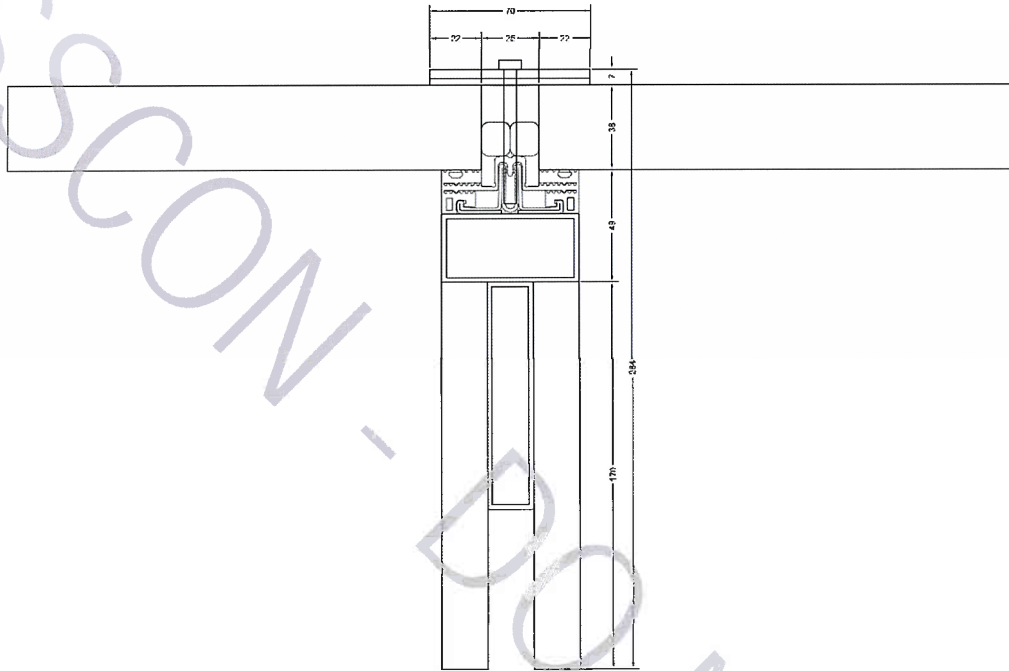


4.6 Section 006



Project: Stavros Niarchos Foundation Cultural Center
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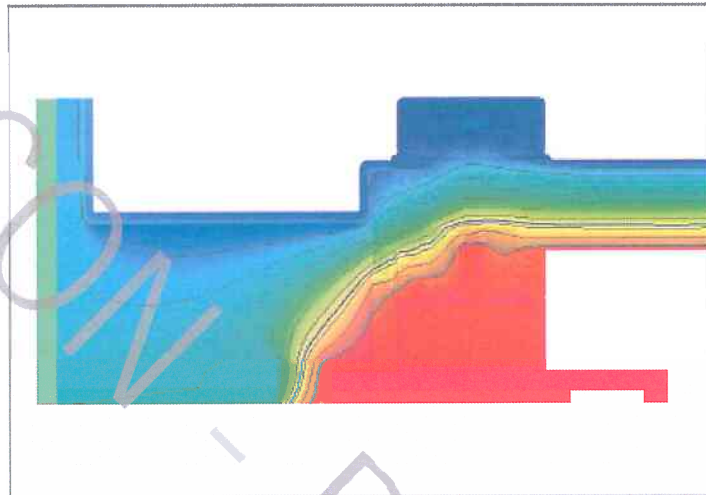
4.7 Section 007



Project: Stavros Niarchos Foundation Cultural Center
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Simulation Software: Frame Simulator 3
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5. Uf Results and Material List for Profile Sections

5.1 Uf Results for Section 001



Node details

Primitives used for finite element simulation: 29362
Frame width (Bf): 250.00 mm
Visible insulation panel width (Bp): 140.00 mm
Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
Surface resistance: 0.13 m²K/W
Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference: 20.000 °C
2D conductance (Lf2D): 0.824 W/mK
Transmittance (Uf): 2.846 W/m²K

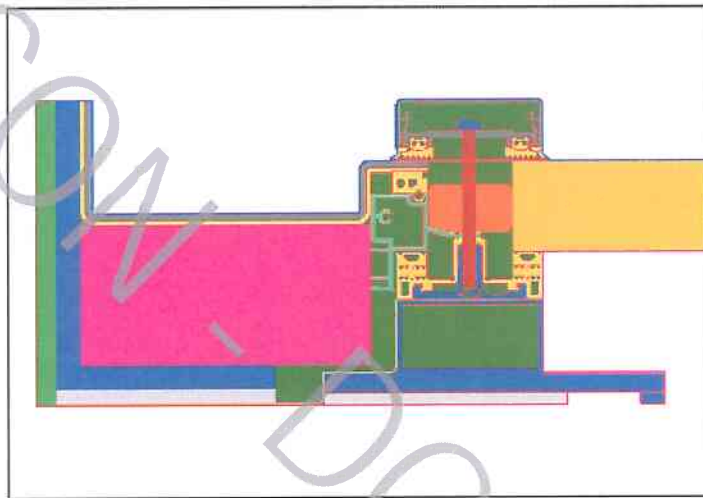
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Steel	Standard	50.0000	50.0000	0.900	Blue
EPS Polystyrene foam closed cell	Standard	0.0340	0.0340	0.900	Red
EPDM	Standard	0.2500	0.2500	0.900	Yellow
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	Grey



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Adiabatic	Adiabatic	0.0000	0.0000	0.900	
Concrete medium density (2200 kg/m3)	Standard	1.6500	1.6500	0.900	
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
PVC-U rigid	Standard	0.2000	0.2000	0.900	
Butyl (isobutene) solid/hot melt	Standard	0.2400	0.2400	0.900	
Screw	13947 Screw	0.2200	0.2200	0.900	



Boundary conditions list:

Name	Col.	R [m²K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

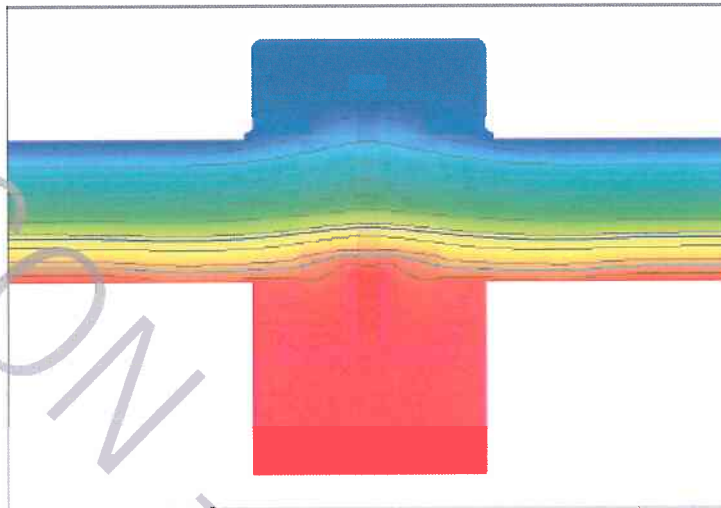
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	6.74	17.98	14.88	13.7288
Internal increased resistance	16.90	17.85	17.46	2.6059
External	0.42	4.16	1.31	16.5526
External increased resistance	-	-	0.00	0.0000



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5.2 Uf Results Section 002



Node details

Primitives used for finite element simulation: 20748
Frame width (Bf): 64.33 mm
Visible insulation panel width (Bp): 187.84 mm
Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
Surface resistance: 0.13 m²K/W
Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference: 20.000 °C
2D conductance (Li2D): 0.372 W/mK
Transmittance (Uf): 1.084 W/m²K

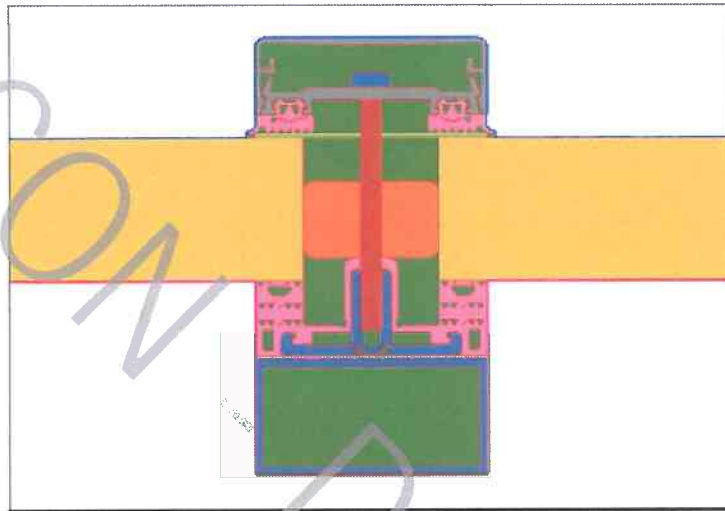
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	Grey
EPDM	Standard	0.2500	0.2500	0.900	Pink
Steel	Standard	50.0000	50.0000	0.900	Blue
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green



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Insulation panel	10077 Insulation	0.0350	0.0350	0.900	
Butyl (isobutene) solid/hot melt	Standard	0.2400	0.2400	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
Screw	13947 Screw	0.2200	0.2200	0.900	



Boundary conditions list

Name	Col.	R [m²K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

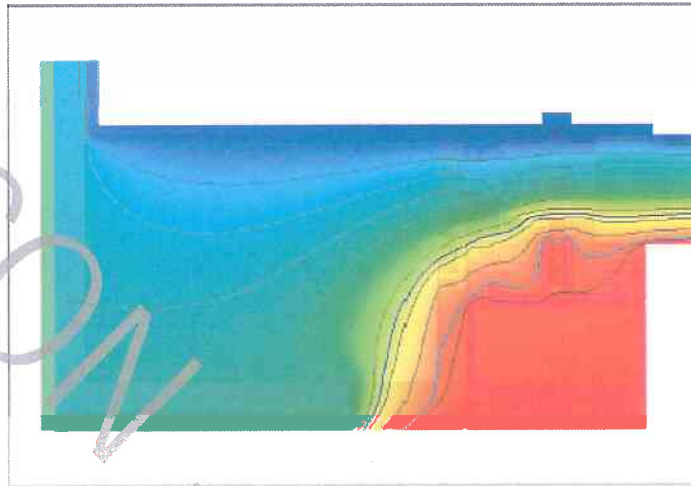
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	17.51	18.57	18.00	5.7784
Internal increased resistance	17.11	18.53	17.96	1.6231
External	0.46	0.91	0.61	-7.4862
External increased resistance	-	-	0.00	0.0000



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5.3 Uf Results Section 003



Node details

Primitives used for finite element simulation: 20757
 Frame width (Ef): 202.56 mm
 Visible insulation panel width (Bp): 187.44 mm
 Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
 Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
 Surface resistance: 0.13 m²K/W
 Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012







Internal/external temperature difference: 20.000 °C
 2D conductance (Lf2D): 0.777 W/mK
Transmittance (Uf): 3.089 W/m²K

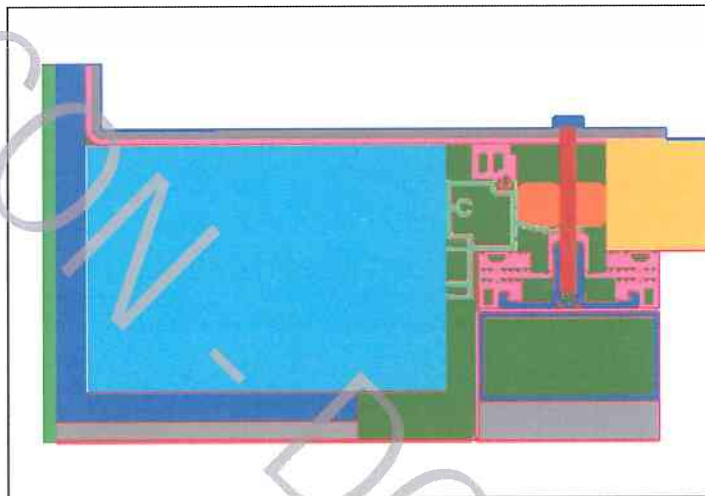
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	Yellow
EPDM	Standard	0.2500	0.2500	0.900	Pink
Concrete medium density (2200 kg/m3)	Standard	1.6500	1.6500	0.900	Grey



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Steel	Standard	50.0000	50.0000	0.900	
EPS Polystyrene foam closed cell	Standard	0.0340	0.0340	0.900	
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
PVC-U rigid	Standard	0.2000	0.2000	0.900	
Screw	13947 Screw	0.2200	0.2200	0.900	



Boundary conditions list:

Name	Col.	R [m²K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

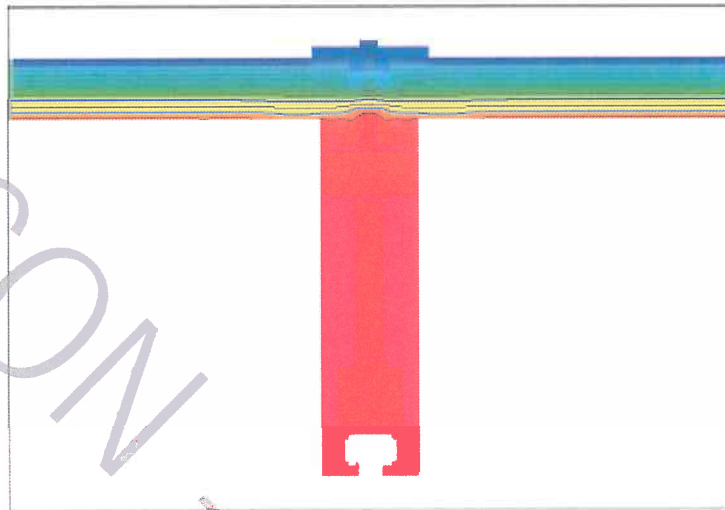
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	8.16	17.91	14.92	13.9927
Internal increased resistance	16.56	17.47	16.89	1.4330
External	0.51	5.49	1.47	-15.6427
External increased resistance	-	-	0.00	0.0000



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5.4 Uf Results Section 004



Node details

Primitives used for finite element simulation: 18986
 Frame width (Bf): 70.00 mm
 Visible insulation panel width (Bp): 185.00 mm
 Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
 Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
 Surface resistance: 0.13 m²K/W
 Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012





Internal/external temperature difference: 20.000 °C
 2D conductance (L_{F2D}): 0.430 W/mK
Transmittance (U_f): 1.881 W/m²K

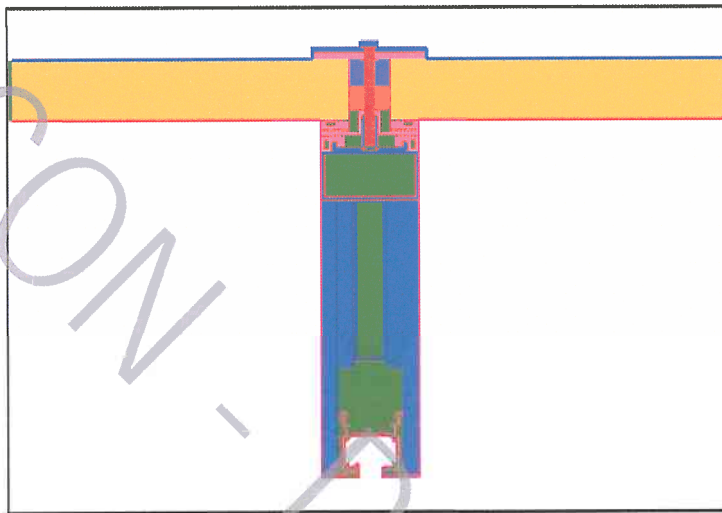
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	
Steel	Standard	50.0000	50.0000	0.900	
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	



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Silicone pure	Standard	0.3500	0.3500	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
EPDM	Standard	0.2500	0.2500	0.900	
Screw	13947 Screw	0.3800	0.3800	0.900	



Boundary conditions list:

Name	Col.	R [m ² K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

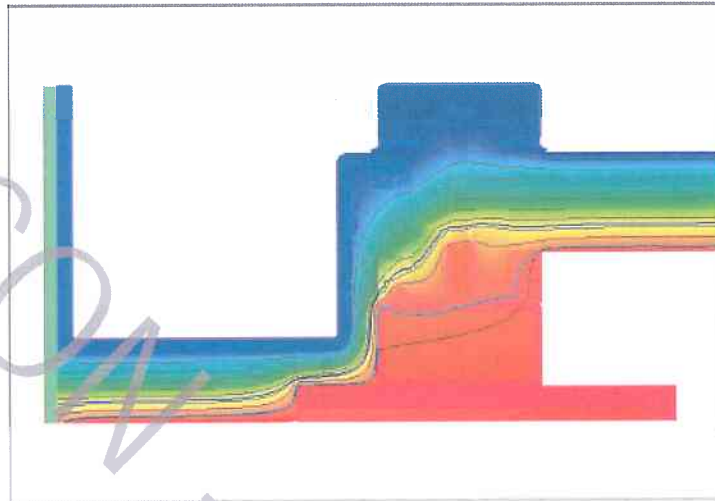
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	17.53	19.45	18.20	5.6243
Internal increased resistance	17.07	19.37	19.00	3.0302
External	0.56	1.14	0.73	-8.5272
External increased resistance	-	-	0.00	0.0000



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Simulation Software: Frame Simulator 3
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5.5 Uf Results Section 005



Node details

Primitives used for finite element simulation: 30534
Frame width (Bf): 230.00 mm
Visible insulation panel width (Bp): 140.00 mm
Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
Surface resistance: 0.13 m²K/W
Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference: 20.000 °C
2D conductance (Lf2D): 0.512 W/mK
Transmittance (Uf): 1.737 W/m²K

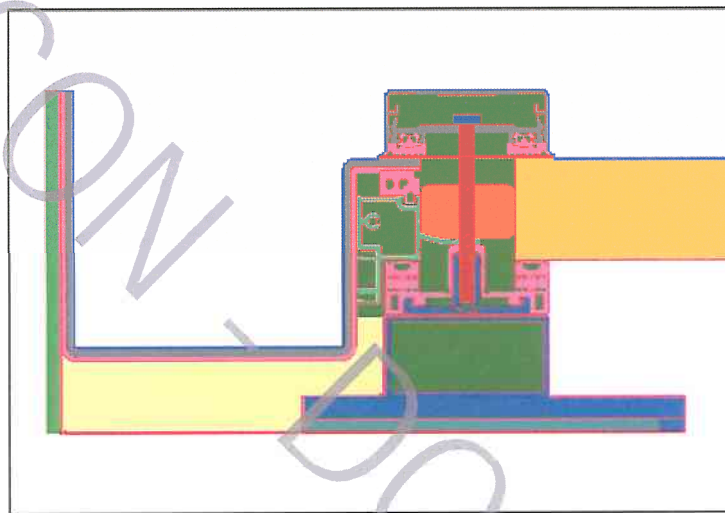
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green
Screw	13947 Screw	0.2200	0.2200	0.900	Red
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	Grey
Steel	Standard	50.0000	50.0000	0.900	Blue



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Butyl (isobutene) solid/hot melt	Standard	0.2400	0.2400	0.900	
PVC rigid	Standard	0.1700	0.1700	0.900	
Concrete high density (2400 kg/m ³)	Standard	2.0000	2.0000	0.900	
EPDM	Standard	0.2500	0.2500	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	
EPS Polystyrene foam closed cell	Standard	0.0340	0.0340	0.900	



Boundary conditions list:

Name	Col.	R [m ² K/W]	H [%]
Internal	Red	0.1300	60.0
Internal increased resistance	Pink	0.2000	60.0
External	Blue	0.0400	60.0

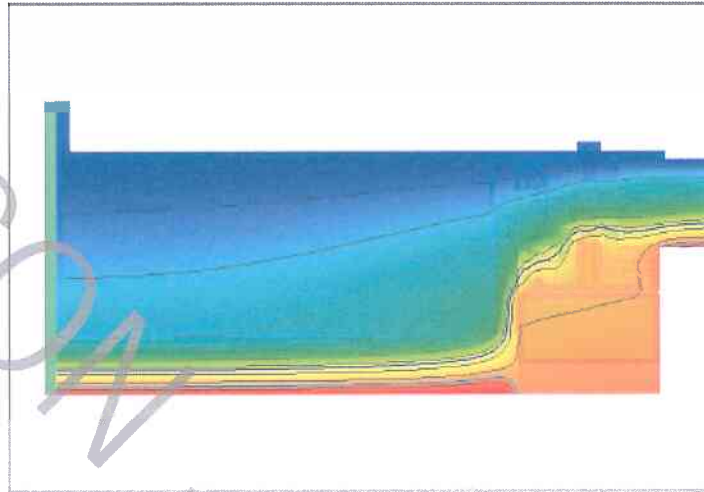
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	15.96	17.99	17.24	7.2150
Internal increased resistance	16.35	17.49	16.82	2.9925
External	0.31	1.12	0.71	-10.2847
External increased resistance	-	-	0.00	0.0000



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5.6 Uf Results Section 006



Node details

Primitives used for finite element simulation: 23259
 Frame width (Bf): 259.56 mm
 Visible insulation panel width (Bp): 187.44 mm
 Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
 Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
 Surface resistance: 0.13 m²K/W
 Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012

Internal/external temperature difference: 20.000 °C
 2D conductance (Lf2D): 0.482 W/mK
Transmittance (Uf): 1.277 W/m²K

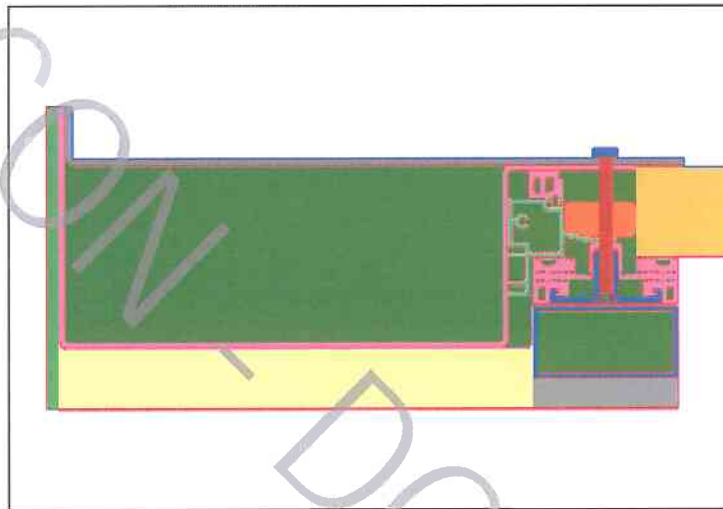
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	Yellow
Screw	13947 Screw	0.2200	0.2200	0.900	Red
Aluminium (anodized/coated)	Standard	160.0000	160.0000	0.900	Grey



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Steel	Standard	50.0000	50.0000	0.900	
EPDM	Standard	0.2500	0.2500	0.900	
PVC-U rigid	Standard	0.2000	0.2000	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	
EPS Polystyrene foam closed cell	Standard	0.0340	0.0340	0.900	
Concrete high density (2400 kg/m3)	Standard	2.0000	2.0000	0.900	



Boundary conditions list:

Name	Col.	R [m²K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

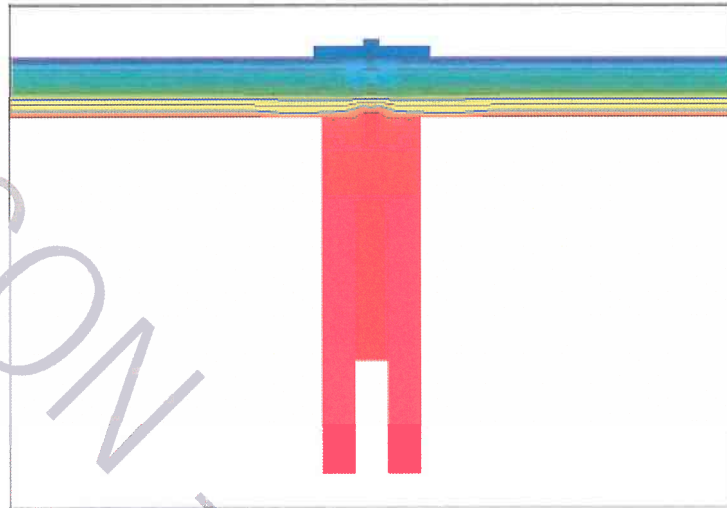
Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	15.64	18.61	17.59	7.6911
Internal increased resistance	15.26	17.44	15.98	1.9303
External	0.55	0.96	0.80	-9.6769
External increased resistance	-	-	0.00	0.0000



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5.7 Uf Results Section 007



Node details

Primitives used for finite element simulation: 17043
Frame width (Bf): 70.00 mm
Visible insulation panel width (Bp): 185.00 mm
Insulation panel thickness (Dp): 37.52 mm

External boundary conditions:

Temperature: 0.000 °C
Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
Surface resistance: 0.13 m²K/W
Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012




Internal/external temperature difference: 20.000 °C
2D conductance (Lf2D): 0.430 W/mK
Transmittance (Uf): 1.882 W/m²K

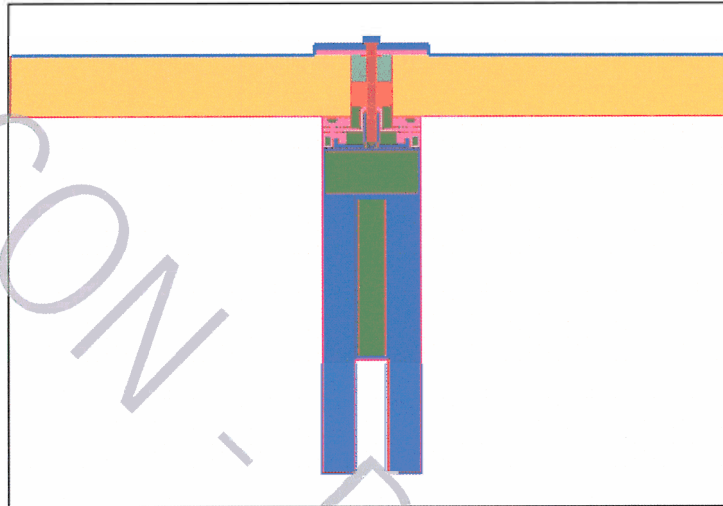
Materials list:

Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green
Insulation panel	10077 Insulation	0.0350	0.0350	0.900	Yellow
Steel	Standard	50.0000	50.0000	0.900	Blue
Screw	13947 Screw	0.3800	0.3800	0.900	Red






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EPDM	Standard	0.2500	0.2500	0.900	
Silicone pure	Standard	0.3500	0.3500	0.900	
PE Polyethylene foam closed cell	Standard	0.0360	0.0360	0.900	



Boundary conditions list:

Name	Col.	R [m²K/W]	H [%]
Internal		0.1300	60.0
Internal increased resistance		0.2000	60.0
External		0.0400	60.0

Boundary conditions analysis:

Name	Min T. [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	17.52	19.39	18.27	5.7041
Internal increased resistance	17.05	19.39	19.06	2.9430
External	0.53	1.13	0.74	-8.5393
External increased resistance	-	-	0.00	0.0000

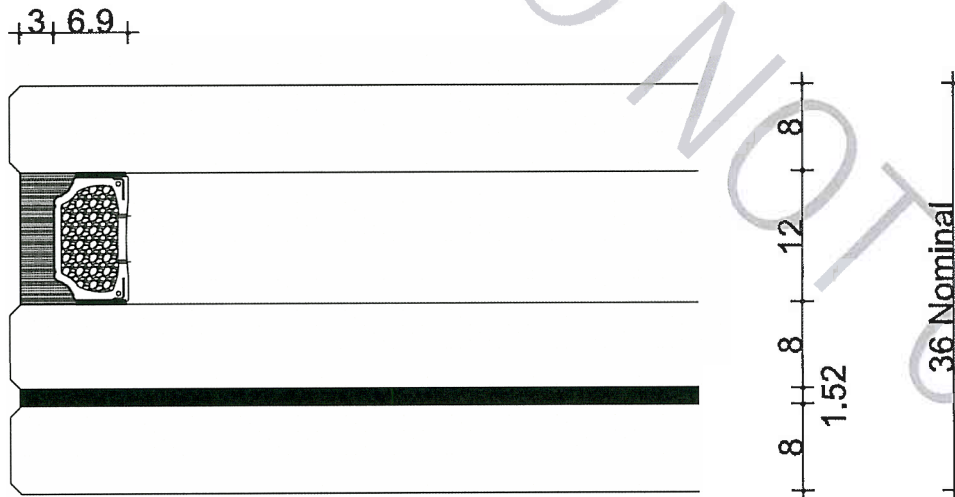


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6. Glass Specification

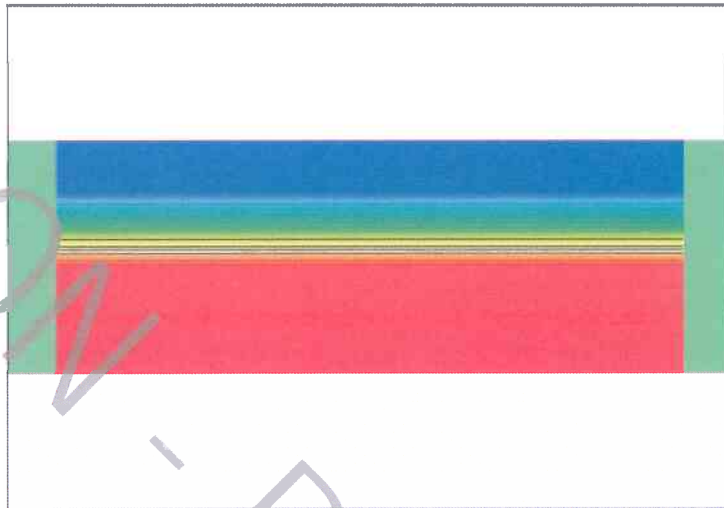
- 6.1 Facade System: FT-07 Skylights
- 6.2 Outdoor Lite: 8mm Fully Tempered
- 6.3 Interspace Content: 12mm Air gas fill
- 6.4 Spacer: warm edge spacer TGI by Technoform
- 6.5 Indoor Lite: 8mm HS + 1.52mm PVB + 8mm Heat Strengthened
- 6.6 Low-E on surface #3: Emissivity value ≤ 0.041
- 6.7 Overall Unit Thickness: 36mm nominal
- 6.8 Overall Glass Assembly U-value: 1.58 W/m² K

7. Dimensioned Drawing for Glass Panel



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8. Ug Results and Material List for Glazing



Node details

Primitives used for finite element simulation: 699
 Frame width (Bf): 100.00 mm
 Visible insulation panel width (Bp): -
 Insulation panel thickness (Dp): -

External boundary conditions:

Temperature: 0.000 °C
 Surface resistance: 0.04 m²K/W

Internal boundary conditions:

Temperature: 20.000 °C
 Surface resistance: 0.13 m²K/W
 Humidity: 60.00 %

Results computed in accordance with EN ISO 10077-2:2012

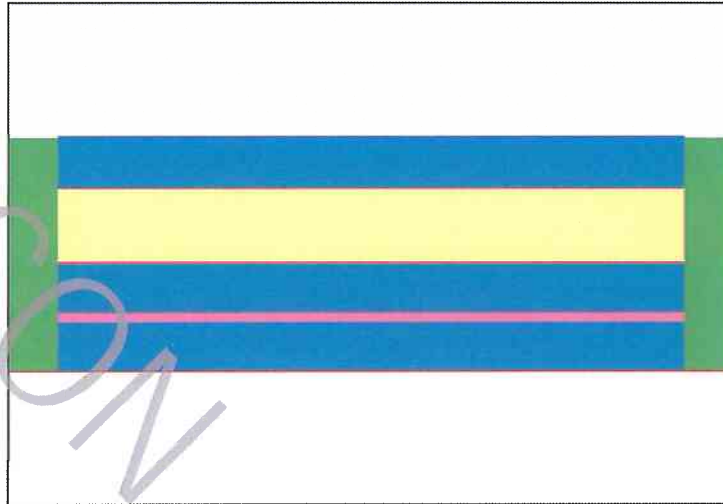
Internal/external temperature difference: 20.000 °C
 2D conductance (Lf2D): 0.158 W/mK
 Transmittance (Uf): **1.580 W/m²K**

Materials list:



Name	Type	λ_x [W/mK]	λ_y [W/mK]	ϵ	Color
Adiabatic	Adiabatic	0.0000	0.0000	0.900	Green
Glass	Standard	1.0000	1.0000	0.900	Blue
PVB	Standard	1.0000	1.0000	0.900	Pink
Air	Gas	0.6162	0.0274	0.900	Yellow
R.s.b. segment	10077 r.s.b. segment	0.5000	0.5000	0.041	Red



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Boundary conditions list:

Name	Col.	R [m ² K/W]	H [%]
Internal		0.1300	60.0
External		0.0400	60.0

Boundary conditions analysis:

Name	Min T [°C]	Max T. [°C]	Av. T. [°C]	Q [W/m]
Internal	15.89	15.89	15.89	3.1600
Internal increased resistance	-	-	0.00	0.0000
External	1.26	1.26	1.26	-3.1600
External increased resistance	-	-	0.00	0.0000



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9. Data Sheet for Warm Edge Spacer

Data sheet Psi values for windows

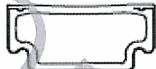
based on determination of the equivalent thermal conductivity of spacers by measurement

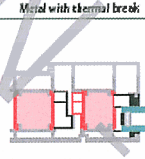
TECHNOFORM GLASSINSULATION

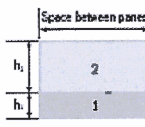


Technoform Glass Insulation GmbH
Matthäus-Merian-Str. 6
D - 34253 Lohfelden



Product name	Spacer height in mm	Material	Thickness d in mm
TGI-Spacer 	6.9	Stainless steel Plastic	0.10 0.6/0.8

Representative frame profile	Metal with thermal break	Plastic	Wood	Wood / Metal
				
Representative psi value of double sheet insulating glass $U_g = 1.1 \text{ W/m}^2\text{K}$	0.049	0.040	0.040	0.044
Representative psi value of triple sheet insulating glass $U_g = 0.7 \text{ W/m}^2\text{K}$	0.044	0.038	0.039	0.042

Two line model characteristic values	Space between panes in mm	$\lambda_{eq,2B}$ in W/mK	
		Box 1 · $h_1 = 3 \text{ mm}$	Box 2 · $h_2 = 6.9 \text{ mm}$
	Can be used for all spacer widths	0.40	0.30

Explanations: The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17/1 "Thermally improved spacers - Determination of the equivalent thermal conductivity by measurement". The representative linear heat transfer coefficients calculated in this way (representative psi values) apply to typical frame profiles and glazing for the determination of the heat transfer coefficient U_w of windows. They have been determined under the boundary conditions (frame profiles, glazing, glass mounting depth, back covering, primary and secondary sealant) defined in the ift guideline WA-06/2 "Thermally improved spacers - Part 1: Determination of the representative Psi value for window frame profiles". This guideline also governs the area of validity and application of the representative psi values. In order to avoid rounding errors, the psi values in the data sheet have been given at 0.001 W/mK. The method for the arithmetical determination of the psi values has an accuracy of $\pm 0.003 \text{ W/mK}$. Differences of less than 0.005 W/mK are not significant. For further information, refer to the Bulletin 004/2006 "Compass 'Warm Edge' for Windows" of Bundesverband Flachglas.

Ermittlung der Kennwerte durch:
Hochschule Rosenheim
University of Applied Sciences
