



## Cálculo del coeficiente de transmisión térmica (Uf)

### Paño Fijo M-Tres, con Poliamida de 15 – Mediterránea RPT

Cliente:

*Alcemar*

Cálculos realizados por

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### Resultados

Ventana de rebatir RTP M-3 mediante BISCO según norma EN ISO 10077-2:2003	Uf = 4,19 W/m <sup>2</sup> K
Ventana de rebatir RTP M-3 mediante RADCON con "Know-How" TECHNOFORM	Uf = 3,40 W/m <sup>2</sup> K

En este informe se determina el coeficiente de transmisión térmica (Uf) mediante dos métodos de cálculo diferentes:

- A) Aplicando la norma EN ISO 10077-2:2003, y usando el software "BISCO" de la empresa Physibel.
- B) Aplicando un método propio, "know-how" de Technoform, donde se usa el software "RADCON"- también propiedad de Physibel - y el valor final equivale aproximadamente al resultado en el test de cálculo de nuestra HOT-BOX (La diferencia es de un 5%) según norma ISO/FDIS 12567:2000.



## Contenido

- Dibujo sistema

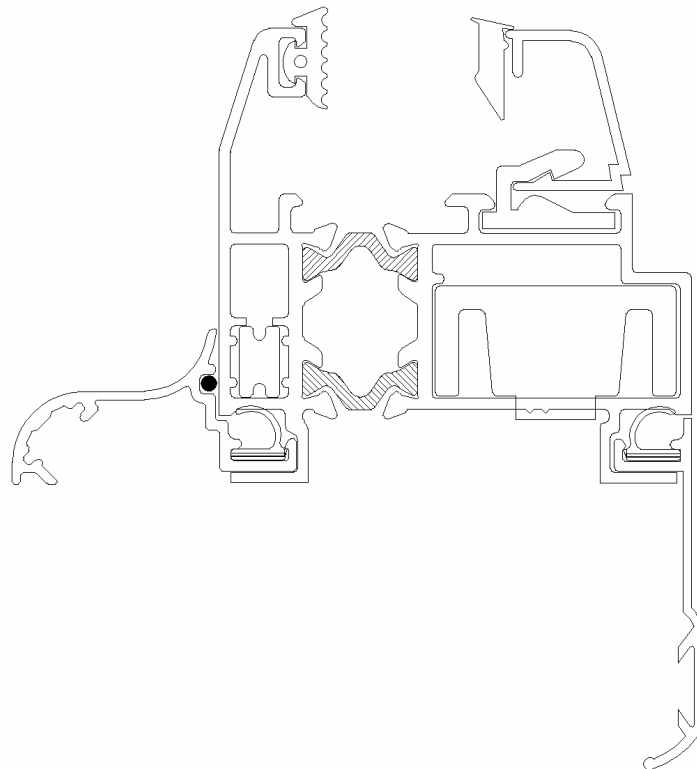
- A) mediante BISCO según norma EN ISO 10077-2:2003

- Input – data BISCO
- Output – data BISCO
- Cálculo del coeficiente de transmisión térmica ( $U_f$ )
- Isotermas
- Flujo de calor

- B) mediante RADCON con “Know-How” TECHNOFORM

- Input – data RADCON
- Output – data RADCON
- Cálculo del coeficiente de transmisión térmica ( $U_f$ )

## Dibujo sistema





**A) mediante BISCO según norma EN ISO 10077-2:2003**

**Input – data BISCO**

Col. Name	Type	CEN-rule	Coupled	lambda [W/mK]	eps [-]	t [°C]	h [W/m²K]
8	aluminium	MATERIAL		160.000			
28	insulation	MATERIAL		0.035			
44	polyamid reinf.	MATERIAL		0.300			
60	EPDM	MATERIAL		0.250			
119	temp. sensor 1	MATERIAL		160.000			
135	temp. sensor 2	MATERIAL		160.000			
151	temp. sensor 3	MATERIAL		160.000			
167	temp. sensor 4	MATERIAL		160.000			
170	exterior	BC_SIMPL	HE			0.0	25.00
174	interior (norma	BC_SIMPL	HI_NORML			20.0	7.70
182	interior (reduc	BC_SIMPL	HI_REDUCE			20.0	5.00
214	cavity (CEN)	EQUIMAT	CEN_VF_I NO	0.137			
215	cavity (CEN)	EQUIMAT	CEN_VF_I NO	0.048			
216	cavity (CEN)	EQUIMAT	CEN_VF_I NO	0.060			
217	cavity (CEN)	EQUIMAT	CEN_VF_I NO	0.108			
218	cavity (CEN)	EQUIMAT	CEN_VF_I NO	0.134			
240	cavity (CEN)	EQUIMAT	CEN_VF_E NO	0.094			
241	cavity (CEN)	EQUIMAT	CEN_VF_E NO	0.098			
251	cavity <3x3 mm2	MATERIAL		0.034			
252	cavity <2x2 mm2	MATERIAL		0.031			
253	cavity <1x1 mm2	MATERIAL		0.028			

Col.	q [W/m²]	ta [°C]	hc [W/m²K]	qc [W/m]	tr [°C]	C1 [-]	C2 [-]	C3 [-]
8								
28								
44								
60								
119								
135								
151								
167								
170	0							
174	0							
182	0							
214						0.025	0.73	0.333333
215						0.025	0.73	0.333333
216						0.025	0.73	0.333333
217						0.025	0.73	0.333333
218						0.025	0.73	0.333333
240						0.025	0.73	0.333333
241						0.025	0.73	0.333333
251								
252								
253								

Calculation parameters

Contour approximation margin (triangulation) = 0 pixels



Iteration cycles = 5  
 Recalculation of CEN values (before each iteration cycle)  
 Maximum number of iterations (per iteration cycle) = 10000  
 Maximum temperature difference = 0.0001°C  
 Max. heat flow divergence for total object = 0.001 %  
 Max. heat flow divergence for any node = 1 %

## Output – data BISCO

Col.	Name	Type	tmin [°C]	tmax [°C]	ta [°C]	flow in [W/m]	flow out [W/m]
8	aluminium	MATERIAL	2.85	11.64			
28	insulation	MATERIAL	1.10	16.21			
44	polyamid reinf.	MATERIAL	3.05	11.24			
60	EPDM	MATERIAL	2.05	12.38			
119	temp. sensor 1	MATERIAL	11.46	11.46			
135	temp. sensor 2	MATERIAL	11.49	11.49			
151	temp. sensor 3	MATERIAL	11.62	11.63			
167	temp. sensor 4	MATERIAL	14.58	14.58			
170	exterior	BC_SIMPL	1.10	3.06		0.00	10.39
174	interior (norma	BC_SIMPL	11.42	16.21		8.77	0.00
182	interior (reduc	BC_SIMPL	11.48	15.41		1.61	0.00
214	cavity (CEN)	EQUIMAT	3.07	11.41			
215	cavity (CEN)	EQUIMAT	2.98	3.06			
216	cavity (CEN)	EQUIMAT	3.06	11.23			
217	cavity (CEN)	EQUIMAT	11.23	11.49			
218	cavity (CEN)	EQUIMAT	2.85	12.20			
240	cavity (CEN)	EQUIMAT	1.76	3.07			
241	cavity (CEN)	EQUIMAT	11.40	12.90			
251	cavity <3x3 mm2	MATERIAL	11.30	11.54			
252	cavity <2x2 mm2	MATERIAL	2.85	2.93			
253	cavity <1x1 mm2	MATERIAL	2.34	11.78			



## Cálculo del coeficiente de transmisión térmica (Uf)

### THERMAL TRANSMITTANCE ACCORDING TO prEN 10077-2

#### Theory

The thermal transmittance of a frame according to PrEN 10077-2:

$$U_f = \frac{L_{2D} - U_p * l_p}{l_f} \quad \text{and} \quad L_{2D} = \frac{q_{l,tot}}{\Delta \theta}$$

- with:
- $U_f$ : thermal transmittance of the window frame [W/m<sup>2</sup>K]
  - $U_p$ : thermal transmittance of the flanking panel [W/m<sup>2</sup>K]
  - $l_p$ : projected width of the flanking panel [m]
  - $l_f$ : projected width of the window frame [m]
  - $L_{2D}$ : two-dimensional coupling coefficient [W/mK]
  - $q_{l,tot}$ : total heat flow through the window frame and the flanking panel [W/m]
  - $\Delta \theta$ : temperature difference between inside ( $\theta_i$ ) and outside ( $\theta_e$ ) [K]

Calculation	Item:		
input data:	$q_{l,tot} =$	10,39 W/m	$R_{se} =$ 0,04 m <sup>2</sup> K/W
	$\theta_e =$	0,0 °C	$R_{si} =$ 0,13 m <sup>2</sup> K/W
	$\theta_i =$	20,0 °C	
	$d_i =$	0,0180 m	
	$\lambda_i =$	0,035 W/m*K	
	$U_p =$	1,461 W/m <sup>2</sup> K	
	$l_p =$	0,190 m	
	calculation results:	$L_{2D} =$ 0,52 W/mK	
	$l_f =$	0,0576 m	$U_f =$ 4,20 W/m <sup>2</sup> K

#### input data using the Physibel Software BISCO

- $q_{l,tot}$ : alphanumeric output BISCO
- heat losses per boundary condition
- $\Delta \theta$ : input data, surface boundary conditions:  
inside temperature minus outside temperature
- $U_p$ : calculation, using the following formula:

$$U_p = \left[ \frac{1}{h_e} + \sum \frac{d_i}{\lambda_i} + \frac{1}{h_i} \right]^{-1}$$

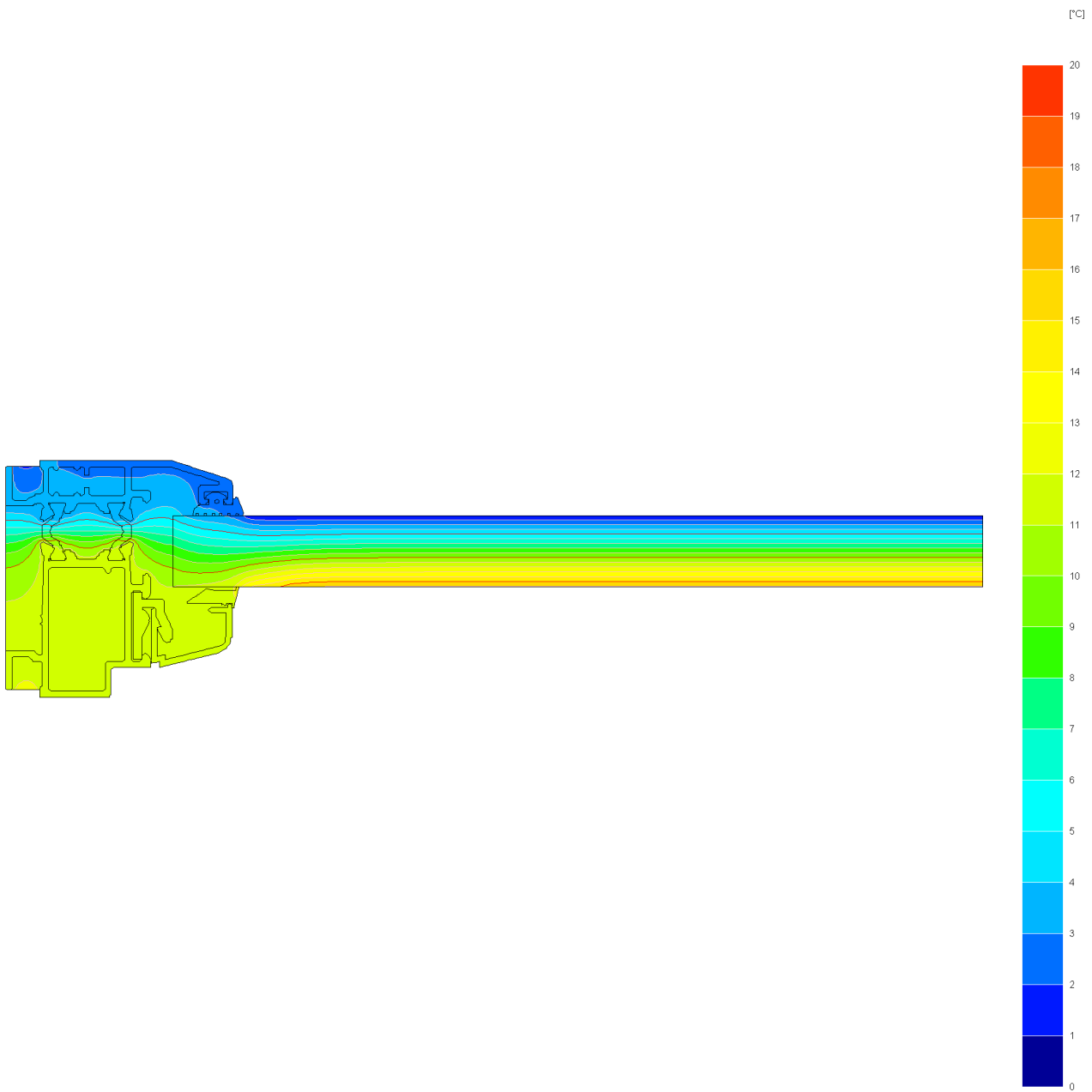
- with:  $h_e / h_i$  ext./int. surface heat transfer coeff. [W/m<sup>2</sup>K]
- $d_i$  thickness of layer i [m]
- $\lambda_i$  thermal conductivity of layer i [W/mK]

- $l_p / l_f$ : input data: dimensions of the item

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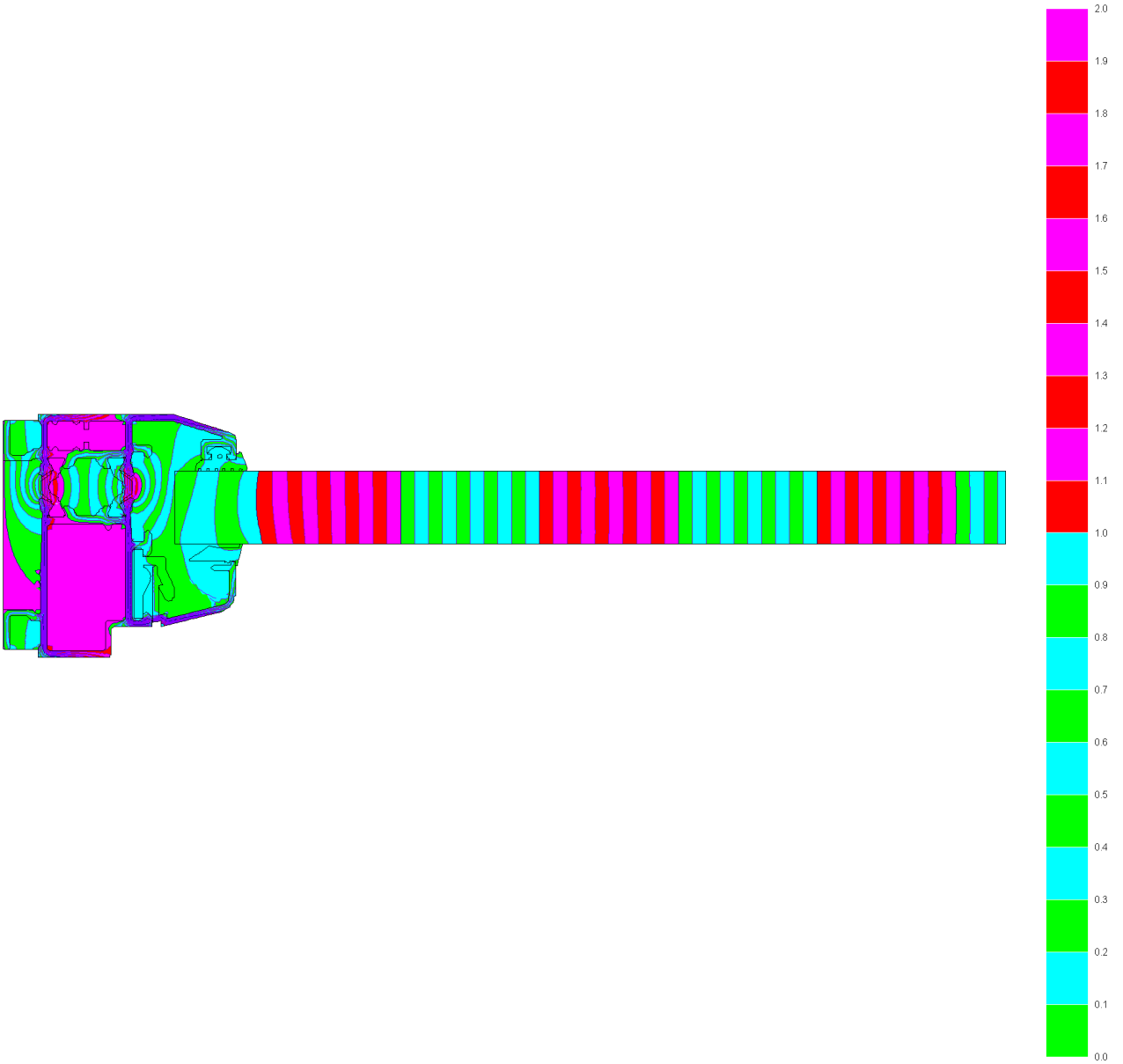
# Isotermas





# Flujo de calor

[W/m]





**B) mediante RADCON con “Know-How” TECHNOFORM**

**Input – data RADCON**

Col.	Name	Type	CEN-rule	Coupled	lambda [W/mK]	eps [-]	t [°C]	h [W/m²K]
8	aluminium	MATERIAL			160.000	0.90		
28	insulation	MATERIAL			0.035	0.90		
44	polyamid reinf.	MATERIAL			0.300	0.90		
60	EPDM	MATERIAL			0.250	0.90		
119	temp. sensor 1	MATERIAL			160.000	0.90		
135	temp. sensor 2	MATERIAL			160.000	0.90		
151	temp. sensor 3	MATERIAL			160.000	0.90		
156	insulation far	MATERIAL			0.035	0.90		
167	temp. sensor 4	MATERIAL			160.000	0.90		
170	exterior	BC_SKY	NIHIL					
174	interior 1	BC_SKY	NIHIL					
182	interior 2	BC_SKY	NIHIL					
190	interior 3	BC_SKY	NIHIL					
214	cavity	BC_FREE	CEN_VF_I	NO				
215	cavity	EQUIMAT	CEN_VF_I	NO	0.048	0.90		
216	cavity	EQUIMAT	CEN_VF_I	NO	0.060	0.90		
217	cavity	BC_FREE	CEN_VF_I	NO				
218	cavity	BC_FREE	CEN_VF_I	NO				
240	cavity	EQUIMAT	CEN_VF_E	NO	0.093	0.90		
241	cavity	EQUIMAT	CEN_VF_E	NO	0.099	0.90		
251	cavity <3x3 mm2	MATERIAL			0.034	0.90		
252	cavity <2x2 mm2	MATERIAL			0.031	0.90		
253	cavity <1x1 mm2	MATERIAL			0.028	0.90		

Col.	q [W/m²]	ta [°C]	hc [W/m²K]	qc [W/m]	tr [°C]	C1 [-]	C2 [-]	C3 [-]
8								
28								
44								
60								
119								
135								
151								
156								
167								
170	0	0.0	12.00		0.0			
174	0	20.0	2.50		20.0			
182	0	20.0	2.65		20.0			
190	0	20.0	3.02		20.0			
214	0		2.04	0		0.0247	0.58	0.25
215						0.0244	0.58	0.25
216						0.0247	0.58	0.25
217	0		1.66	0		0.025	0.58	0.25
218	0		2.05	0		0.0248	0.58	0.25
240						0.0243	0.58	0.25
241						0.0251	0.58	0.25
251								
252								
253								





Calculation parameters

Contour approximation margin (triangulation) = 0 pixels  
 Iteration cycles = 5  
 Nonlinear radiation  
 Recalculation of CEN values (before each iteration cycle)  
 Smallest accepted viewfactor = 0.001  
 Number of visibility rays between radiative surfaces = 100  
 Black radiation heat transfer coeff. (linear radiation) = 5.25 W/m<sup>2</sup>K  
 Maximum number of iterations (per iteration cycle) = 10000  
 Maximum temperature difference = 0.0001°C  
 Max. heat flow divergence for total object = 0.001 %  
 Max. heat flow divergence for any node = 1 %

**Output – data RADCON**

Col.	Name	Type	tmin [°C]	tmax [°C]	ta [°C]	flow in [W/m]	flow out [W/m]
8	aluminium	MATERIAL	3.67	13.43			
28	insulation	MATERIAL	1.74	15.72			
44	polyamid reinf.	MATERIAL	3.79	13.21			
60	EPDM	MATERIAL	2.98	13.57			
119	temp. sensor 1	MATERIAL	13.34	13.35			
135	temp. sensor 2	MATERIAL	13.36	13.36			
151	temp. sensor 3	MATERIAL	13.43	13.43			
156	insulation far	MATERIAL	1.72	16.26			
167	temp. sensor 4	MATERIAL	15.29	15.29			
170	exterior	BC_SKY	1.72	3.79		0.00	9.31
174	interior 1	BC_SKY	15.72	16.26		4.92	0.00
182	interior 2	BC_SKY	13.43	15.72		1.12	0.00
190	interior 3	BC_SKY	13.31	14.47		3.26	0.00
214	cavity	BC_FREE	3.80	13.31	10.11	0.70	0.70
215	cavity	EQUIMAT	3.74	3.80			
216	cavity	EQUIMAT	3.80	13.20			
217	cavity	BC_FREE	13.20	13.36	13.28	0.02	0.02
218	cavity	BC_FREE	3.68	13.45	9.73	1.48	1.48
240	cavity	EQUIMAT	2.56	3.80			
241	cavity	EQUIMAT	13.30	14.47			
251	cavity <3x3 mm2	MATERIAL	13.24	13.38			
252	cavity <2x2 mm2	MATERIAL	3.67	3.78			
253	cavity <1x1 mm2	MATERIAL	3.23	13.50			



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  - $U_p$  : thermal transmittance of the flanking panel [W/m<sup>2</sup>K]
  - $l_p$  : projected width of the flanking panel [m]
  - $l_f$  : projected width of the window frame [m]
  - $L_{2D}$  : two-dimensional coupling coefficient [W/mK]
  - $q_{l,tot}$  : total heat flow through the window frame and the flanking panel [W/m]
  - $\Delta \theta$  : temperature difference between inside ( $\theta_i$ ) and outside ( $\theta_e$ ) [K]

Calculation	Item:		
input data:	$q_{l,tot} =$	9,310 W/m	$R_{se} =$ 0,06 m <sup>2</sup> K/W
	$\theta_e =$	0,0 °C	$R_{si} =$ 0,13 m <sup>2</sup> K/W
	$\theta_i =$	20,0 °C	
	$d_i =$	0,0180 m	
	$\lambda_i =$	0,035 W/m*K	
	$U_p =$	1,420 W/m <sup>2</sup> K	
	$l_p =$	0,190 m	
	calculation results:		$L_{2D} =$ 0,47 W/mK
	$l_f =$	0,0576 m	$U_f =$ 3,40 W/m <sup>2</sup> K

#### input data using the Physibel Software BISCO

- $q_{l,tot}$  : alphanumeric output BISCO  
heat losses per boundary condition
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inside temperature minus outside temperature
- $U_p$  : calculation, using the following formula:

$$U_p = \left[ \frac{1}{h_e} + \sum \frac{d_i}{\lambda_i} + \frac{1}{h_i} \right]^{-1}$$

- with:  $h_e / h_i$  : ext./int. surface heat transfer coeff. [W/m<sup>2</sup>K]
- $d_i$  : thickness of layer i [m]
- $\lambda_i$  : thermal conductivity of layer i [W/mK]

- $l_p / l_f$  : input data: dimensions of the item

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