

1. Introduction

This tutorial explains how to determine the linear thermal transmittance of a glazing spacer (for the window profile of tutorial a) according to the European standard EN ISO 10077-2 with BISCO.

Key elements:

- Adjusting a BISCO file by importing a BMP
- Application of BiscoBmp
- Derived thermal properties: linear thermal transmittance of a junction of a frame profile with a glazing (ψ_g)

2. Case study data

[alu_1_frame_panel.bsc](#)
[glazing_spacer_4_16_4_aluminium.bmp](#)
[alu_1_frame_glazed.bsc](#)

The case study data considers the frame of tutorial a and a double glazing with an aluminium spacer.

We want to replace the insulation panel by a double glazing, in order to calculate the linear thermal transmittance of the spacer at the glazing edge.



3. Method a: import glazing within BISCO

- A bitmap of the glazing with spacer is available in the file [glazing_spacer_4_16_4_aluminium.bmp](#) with the same thickness (24 mm) and pixel resolution (0.1 mm) as the insulation panel.
- Open the BISCO file [alu_1_frame_panel.bsc](#) (*File* → *Open...*).
- Choose *Zoom* → *Select*, zoom in on the top left corner of the insulation panel and click with the left mouse button on this corner pixel. This is to initialise the reference pixel for the bitmap to import.
- Choose the function *Bitmap* → *Import Bitmap...* and choose the file [glazing_spacer_4_16_4_aluminium.bmp](#).
- Then the Bitmap Origin dialog box appears. The reference pixel coordinates are initialised using the last clicked pixel in "select mode". Press OK.

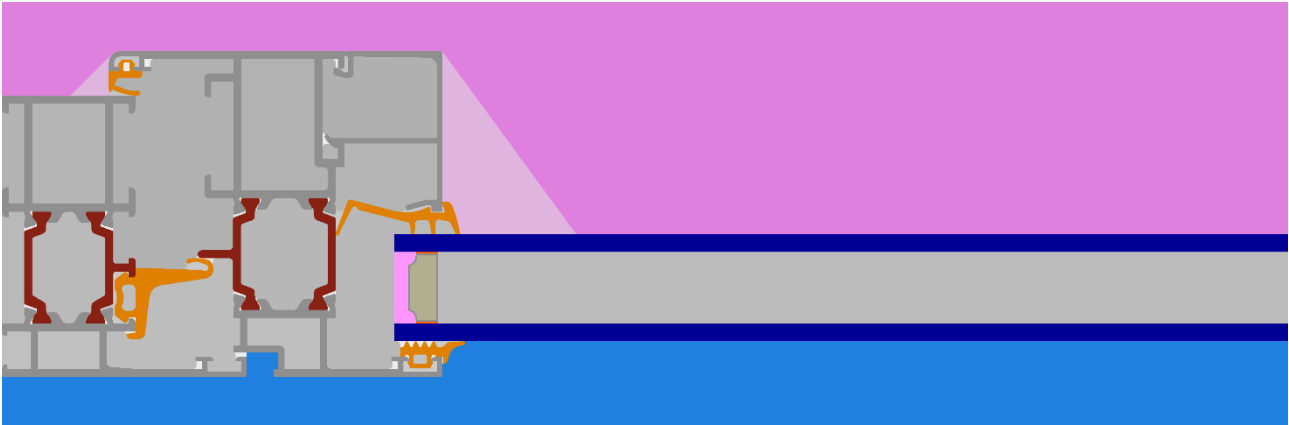
Bitmap Origin

Reference Pixel X = 882 Y = 520

Position

☒ Top Left
☐ Top Right
☐ Bottom Left
☐ Bottom Right

OK Cancel



- The colours in the imported bitmap have been chosen in accordance to the used template Colour database. Only the cavity (colour 17) must be defined as EQUIMAT with a user defined thermal conductivity, e.g. $\lambda_{eq} = 0.022 \text{ W/(m.K)}$, to obtain the thermal transmittance of the glazing as indicated in the **Border U Values** window (here $U_g = 1.105 \text{ W/(m}^2\text{.K)}$ at the right bitmap border).

alu_1_frame_glazed.bmp

Measures

Col.	Width [pix.]	Width [m]	Height [pix.]	Height [m]	Area [pix.]	Zones	Triang. [pix.]
1	0.0001	1	0.0001				
All	2890	0.2890	950	0.0950			50.00
8	990	0.0990	730	0.0730	110655	5	50.00
17	1910	0.1910	160	0.0160	305600	1	50.00
18	2008	0.2008	240	0.0240	160640	2	50.00
44	700	0.0700	280	0.0280	28118	4	50.00
60	801	0.0801	692	0.0692	26414	4	50.00
86	49	0.0049	160	0.0160	5766	1	50.00
92	49	0.0049	160	0.0160	356	2	50.00
105	59	0.0059	146	0.0146	7952	1	50.00
170	2890	0.2890	190	0.0190	472377	1	
174	2890	0.2890	520	0.0520	1055872	1	
182	1136	0.1136	411	0.0411	62997	5	
192	258	0.0258	183	0.0183	44554	1	50.00
193	276	0.0276	471	0.0471	111706	1	50.00
194	195	0.0195	294	0.0294	49802	1	50.00
195	50	0.0050	224	0.0224	10366	1	50.00
196	164	0.0164	224	0.0224	36736	1	50.00
197	231	0.0231	153	0.0153	30436	1	50.00
198	35	0.0035	34	0.0034	1055	1	50.00
199	195	0.0195	250	0.0250	39010	1	50.00
200	190	0.0190	364	0.0364	48745	1	50.00
201	53	0.0053	250	0.0250	12388	1	50.00
202	164	0.0164	250	0.0250	31237	1	50.00

Colours

Col.	Type	Subtype	Physical flow dir.	Geometrical flow dir.	Name	c1 / c2 [- / -]	λ [W/mK]	c [-]	θ [°C]	h [W/m²K]	q [W/m²]	θ_a [°C]	h_c [W/m²K]	P_c [W/m]	θ_r [°C]	Standard
8	MATERIAL				aluminium		160.000									
17	EQUIMAT	NIHIL			equivalent $U_s=1.1 \text{ W/m}^2\text{K}$		0.022									NIHIL
18	MATERIAL				soda lime		1.000									
44	MATERIAL				polyamide 6,6 with 25 % glass fibre		0.300									
60	MATERIAL				EPDM		0.250									
86	MATERIAL				polysulfide		0.400									
92	MATERIAL				butyl hot melt		0.240									
105	MATERIAL				molecular sieve		0.100									

Border U Values

Bitmap Border	U [W/m²K]	Enforced U [W/m²K]
Left	1.207	2.962
Right	1.105	
Top		
Bottom		

- Alternatively, the user can define the properties of glazing. IN EQUIMAT type with standard EN673, emissivity values of glass surfaces and the ratio of gases filling the space can be entered. Software calculates the equivalent thermal conductivity based on EN 673 standard. W/m^2K
- Gas filling space consists of 90% Argon and 10% Air. The emissivity values are $e1/e2 = 0.873/0.03$. Both method results in $U_g=1.1 W/(m^2.K)$ as indicated in the **Border U Values window**.

Col.	Type	Subtype	Physical flow dir.	Geometrical flow dir.	Name	ϵ_1 / ϵ_2 [- / -]	λ [W/mK]	c [J]	θ [°C]	h [W/m²K]	q [W/m²]	ϵ_a [°C]	h_c [W/m²K]	P_c [W/m]	ϵ_r [°C]	Standard
8	MATERIAL				aluminium		160.000									
17	EQUIMAT	LAYER	HOR	Y	90%Argon 10%Air	0.84 / 0.03	0.022									EN673
18	MATERIAL				soda lime		1.000									
44	MATERIAL				polyamide 6,6 with 25 % glass fibre		0.300									
60	MATERIAL				EPDM		0.250									
86	MATERIAL				polysulfide		0.400									
92	MATERIAL				butyl hot melt		0.240									
105	MATERIAL				molecular sieve		0.100									
170	BC_SIMPL	HE	HOR		exterior				0.0	25.00	0					EN10077
174	BC_SIMPL	HI_NORML	HOR		interior (normal), horizontal heat flow				20.0	7.70	0					EN10077

- Enter as enforced U value (in the **Border U Values window**) the thermal transmittance of the frame ($U_f = 2.962 W/(m^2.K)$), as calculated in tutorial a for the left bitmap border.

In the calculation of the linear thermal transmittance (see below), this enforced U value will be used over the projected width of the frame section, while the U value of the glazing will be used over the visible width of the glazing.

- The flanking elements are defined in the Derived Thermal Properties dialog box (*Edit → Derived Thermal Properties...*) as in the figure below.

Derived Thermal Properties

☐ Temperature factor (f)

☒ Linear thermal transmittance (psi) & equivalent thermal transmittance (Ueq)

☒ 1st flanking element
U value in bitmap section : ☒ Left
☐ Right
☐ Top
☐ Bottom
☐ Distance
U value along distance no.:
Width along distance no.:
☐ Add width distance no.:

☒ 2nd flanking element
U value in bitmap section : ☐ Left
☒ Right
☐ Top
☐ Bottom
☐ Distance
U value along distance no.:
Width along distance no.:
☐ Add width distance no.:

☐ Thermal transmittance of frame (Uf)

Frame width along dist. no.: ☐ Add width along dist. no.:

☒ 1st panel
U panel in bitmap section : ☐ Left
☒ Right
☐ Top
☐ Bottom
☐ Distance
U value along distance no.:
Width along distance no.:

☐ 2nd panel
U panel in bitmap section : ☐ Left
☒ Right
☐ Top
☐ Bottom
☐ Distance
U value along distance no.:
Width along distance no.:

☐ Internal surface relative humidity

Inside zone RH: %

☒ Surface RH = 100 % (surface condensation)

☒ Surface RH >= %

OK Cancel

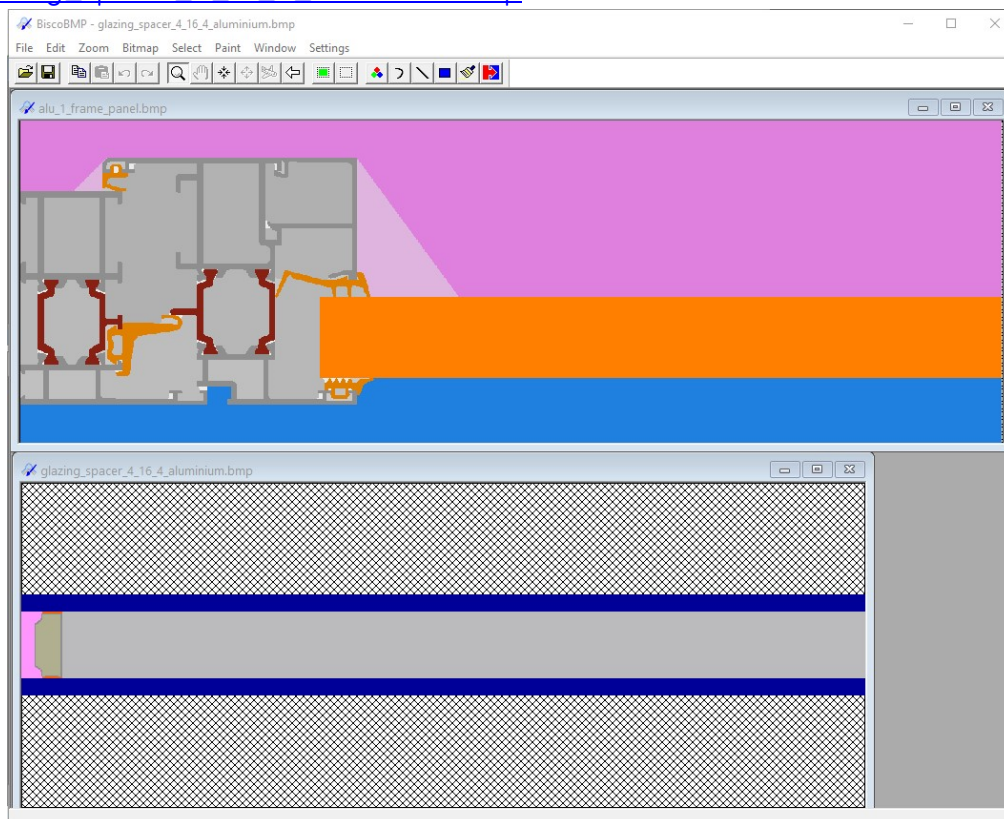
- Save the current data (*File → Save As...*) as Frame_glazed.bmp and Frame_glazed.bsc.

- Calculate the system (*Calc* → *Calc System*).
- Go to the **Text Output window** (*Output* → *Text Output*) to see the linear thermal transmittance ($\Psi = 0.080 \text{ W/(m.K)}$).

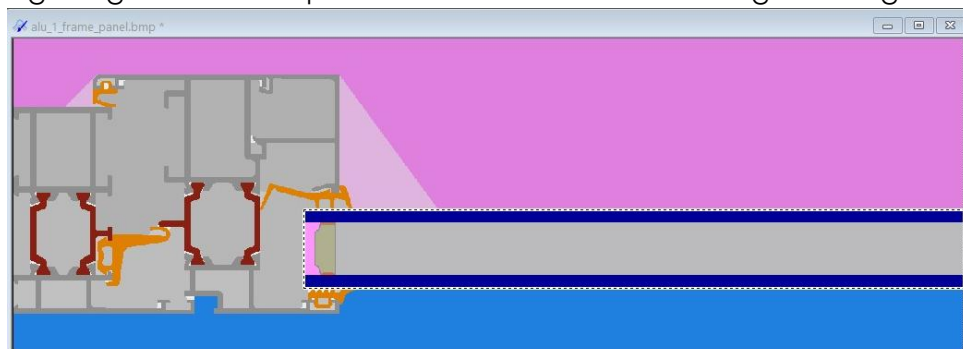
4. Method b: import glazing within BiscoBmp

An alternative method is to import the glazing within the subprogram BiscoBmp:

- Open the BISCO file [alu_1_frame_panel.bsc](#) (*File* → *Open...*).
- Save the BISCO file under a different name (*File* → *Save as...*).
- Open the corresponding BMP in BiscoBmp from within BISCO via *Bitmap* → *Edit using BiscoBmp*.
- Within BiscoBmp open a second bitmap with the glazing *File* → *Open...* and select [glazing_spacer_4_16_4_aluminium.bmp](#).



- Select and copy the double glazing and spacer by activating the corresponding window (left mouse click in window) and press <Ctrl+A> and then press <Ctrl+C>.
- Activate thereafter the bitmap window with the frame and press <Ctrl+V>.
- The double glazing can now be positioned in the frame according to the figure below.



- By saving and closing BiscoBmp the modified BMP becomes directly available in BISCO.