

Laboratory for Thermal Performance and Acoustics
Building Physics Department

Notified testing laboratory No. 1404 CPR – EU Regulation No. 305/2011

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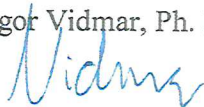
REPORT

No. P 0612/13-520-4

**on initial type calculation of thermal transmittance
 U_f of frame of PVC profile according to SIST EN
ISO 10077-2:2012, SIST EN ISO 10077-1:2007 and
product standard SIST EN 14351-1:2006+A1:2010**

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Order:	Payment according to Proforma Invoice 13-013-000062, dated 19 th June 2013

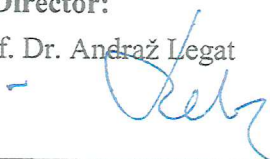
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Obr. P.S. 12-001-01/2

1 Introduction

The applicant has asked ZAG to calculate the thermal transmittance of PVC window frame. The calculation of a profile has been done on the base of delivered scheme in accordance with the standard SIST EN ISO 10077-2:2012, the calculation of a whole window according to the SIST EN ISO 10077-1:2007.

2 Calculation of U_f

The numerical simulation of the heat transfer through the frames has been calculated using program WinIso 2D, version 7.73. In all the simulations convergence parameter is 10^{-5} K for temperature and 0.0005% for heat flow. Autorelax and anisotrop cavity alghoritmns are used.

The results of the calculation and their details are given at point 3 of this Report. The simulations of the air spaces in the frame have been done according to the standard SIST EN ISO 10077-2:2012, thus the air spaces have been taken into account as materials with equivalent thermal conductivities. Used number of the outer-iterations in the simulation for the determination of the parameters was 5. The taken emissivity of the materials $\varepsilon = 0.9$, except for the galvanized (zinc) steel in the closed cavities for which $\varepsilon = 0.3$ (all according to the SIST EN ISO 10077-2:2012).

The table of the employed thermal conductivities:

<i>Materials</i>	<i>thermal conductivity</i> [W/mK]	<i>materials</i>	<i>thermal conductivity</i> [W/mK]
PVC	17	Sealant - EPDM	0.25
Steel	50	Panel	0.035

The data are taken from the SIST EN ISO 10077-2:2012.

The table of the employed boundary conditions:

	<i>temperature</i> [°C]	<i>thermal resistance</i> [m ² K/W]
external	0	0,04
internal - normal	20	0,13
internal – reduced	20	0,20

2.1 Results

The geometric data of the frame:

The width of the frame is 70 mm.

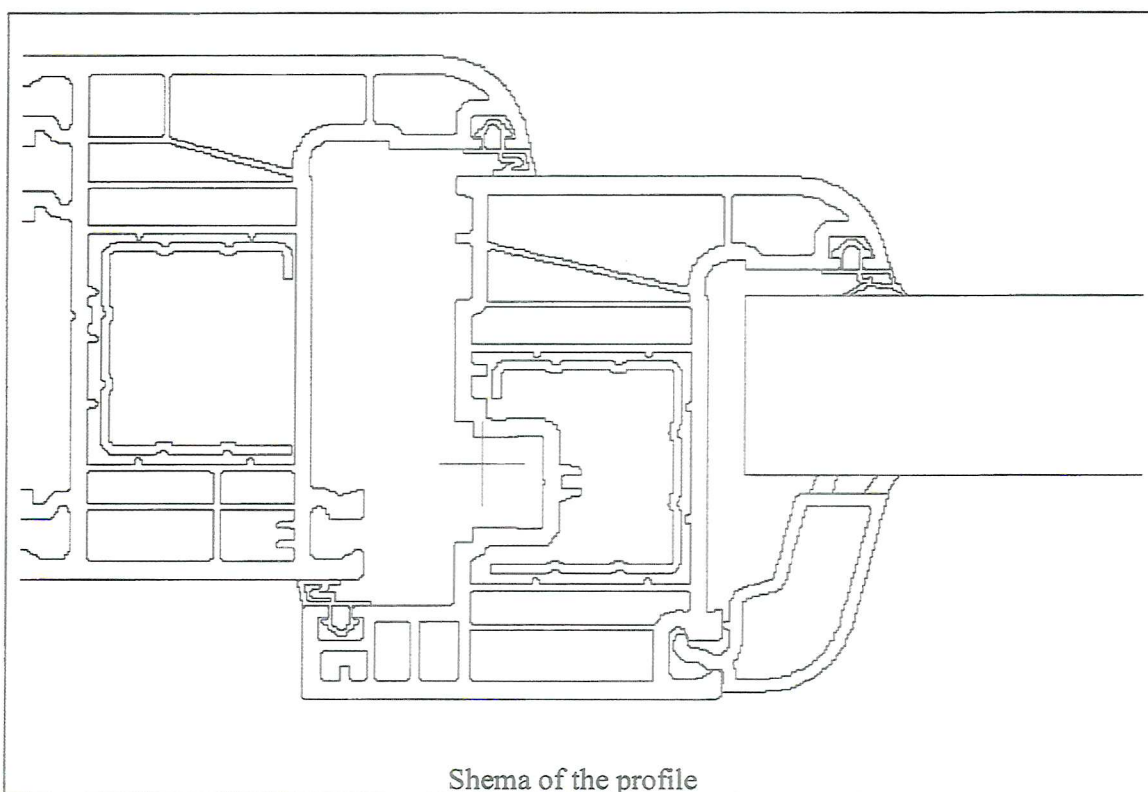
The frame area (calculated for 1 m length):

The internal projected frame area: $A_{f,i} = 0.116 \text{ m}^2$

The external projected frame area: $A_{f,e} = 0.116 \text{ m}^2$

The internal developed frame area: $A_{f,i,d} = 0.156 \text{ m}^2$

The external developed frame area: $A_{f,e,d} = 0.142 \text{ m}^2$



Shema of the profile

number of elements in the simulation::

horizontal direction - 368,

vertical direction - 593

(the direction are taken as the profile is built in
at the bottom of a window)

$l_f = 115.8 \text{ mm}$, $l_p = 190.0 \text{ mm}$

$d_p = 24.0 \text{ mm}$

$U_p = 1.169 \text{ W/m}^2\text{K}$

$Q = 7.52 \text{ W/m}$, $L_{2D} = 0.376 \text{ W/mK}$

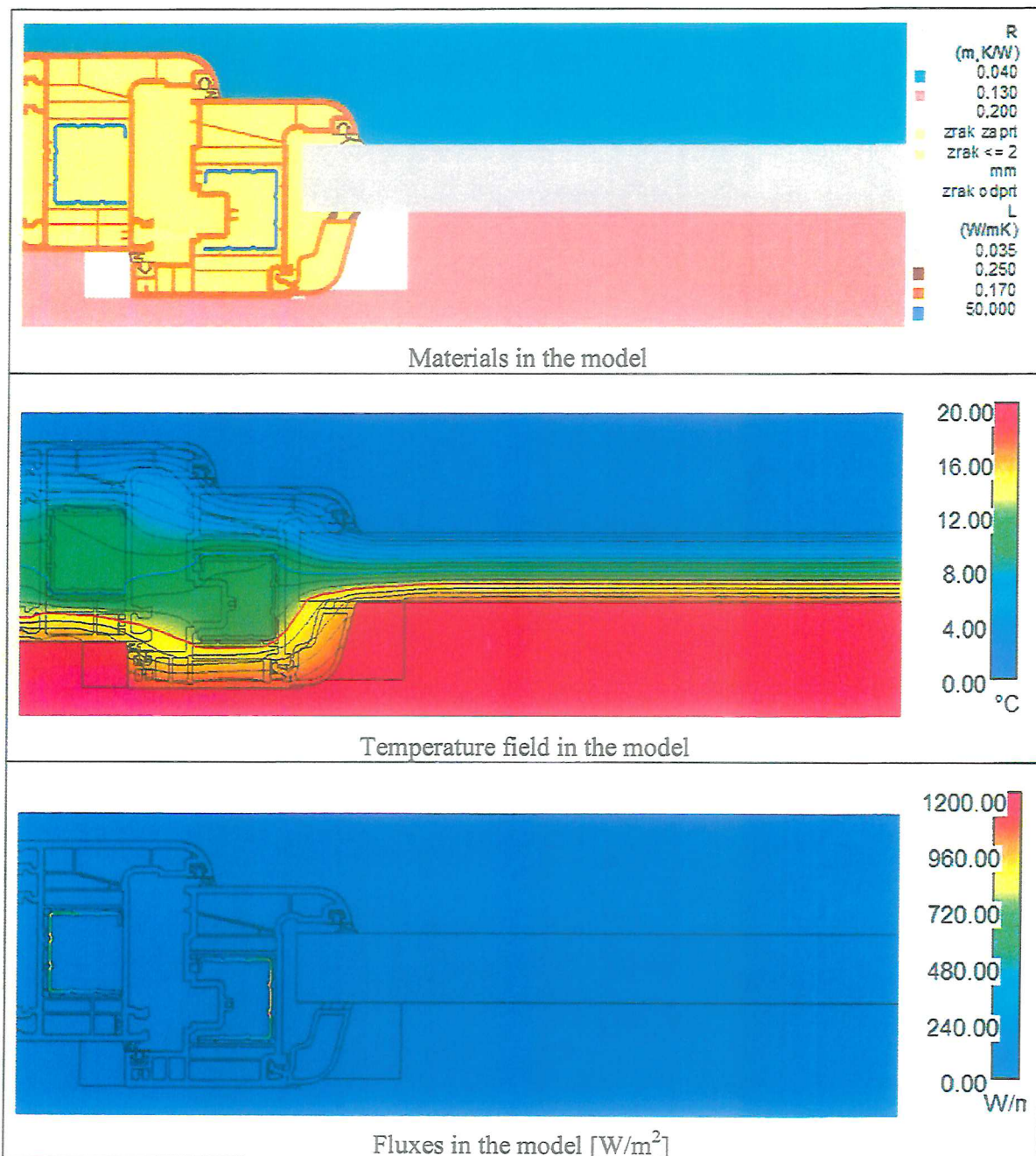
$U_f = 1.3 \text{ W/m}^2\text{K}$

(informative $U_f = 1.33 \text{ W/m}^2\text{K}$)

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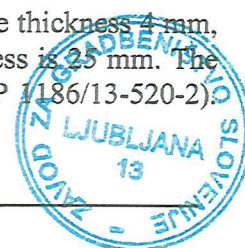


3 Glazing and spacer

A glazing unit for windows consists of 2 glass panes at one side, each of the thickness 4 mm, a cavity of the width 13 mm and another glass pane of 4 mm - total thickness is 25 mm. The thermal transmittance of the glazing unit is $U_g = 1.1 \text{ W/m}^2\text{K}$ (ZAG report P 1186/13-520-2).

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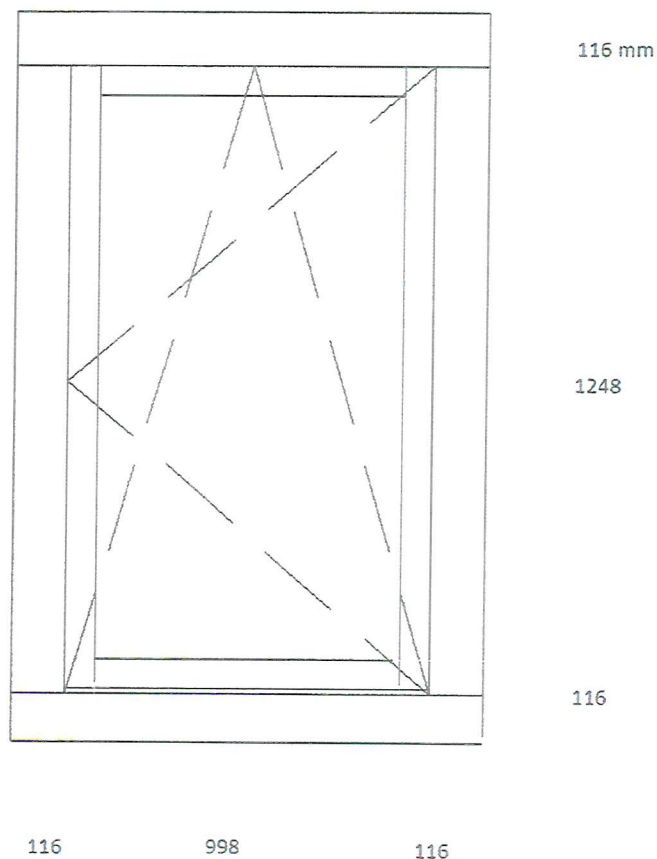


The calculation of U_w for windows has been done for the aluminous spacer with the linear thermal transmittance $\psi_g=0.08$ W/mK (according to the SIST EN ISO 10077-1:2007).

4 Calculation of U_w

According to the SIST EN ISO 10077-1:2007 the thermal transmittance of the window or door shall be given to two significant figures (point 7.7 of the standard). We calculated it for the dimensions of the window of 123 cm $\times$ 148 cm, which according to the SIST EN 14351-1:2006 cover all dimensions of the total area less than 2.3 m².

4.1 Result for one-leaf single window – size 123 cm $\times$ 148 cm



Parameters:

Area of the window:

$$A_w = 1.82 \text{ m}^2$$

Area of the glazing:

$$A_g = 1.25 \text{ m}^2$$

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Area of the frame:

$$A_f = 0.57 \text{ m}^2$$

Circumference of the glazing:

$$l_g = 4.49 \text{ m}$$

Thermal transmittance of the frame:

$$U_f = 1.33 \text{ W/m}^2\text{K}$$

Linear thermal transmittance:

$$\psi_g = 0.08 \text{ W/mK}$$

Result:

U_w	1.4 W/m²K (1.37 W/m ² K)*
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*result is written informative

Calculated and reported by:

Gregor Vidmar

