Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 77 (1998)

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DOI: https://doi.org/10.5169/seals-58276

Influence of the Glass Paned Areas on the Closing Walls of Buildings

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Summary

With a look on establishing an adequate value of the thermal transmission resistance, the study analyses the necessary of heat for an area considering separately the losses of heat through the opaque area of the wall, the losses through the glass pane area and the necessary heating for the cold air infiltrated through joinery leaks and their weight in the entire heat necessary for different percentages of the glass pane area in relation with the total area of the wall.
This way a good thermal insulation will be achieved by diminishing, at first, the losses of heat of great weight in the total heat necessary.

Introduction

The glass pane elements must meet some functional demands concerning illumination, thermal protection, architectural plasticity, etc.
In order to respect the minimal illumination index, which takes values between 10 - 16 % for dwellings, in relation with the rooms' purpose, minimal dimensions must be established for windows. But the glass paned surfaces are parts with much lower thermal resistance than the opaque parts of the walls, the thermal energy lost through the windows (by direct transmission and by heating the infiltrated cold air) having an important weight in the building heating.
In this context, the problem of reducing the heat losses through the glass paned parts of the walls naturally imposes.

The hygrothermal behaviour of glass paned closing walls

The thermal energy losses per hour can be expressed by the relation:

$$Qp = \left[\left(\sum KosSs + \sum KoFSF\right)\left(1 + \frac{\sum A}{100}\right) + \sum Ljijv^{4/3}\right]\Delta T \qquad (1)$$

where S_s and S_f are the opaque surfaces of the windows, having the thermal transfer coefficients K_{OS} and K_{OF}; L_j is the length of the joinery spaces through which the cold air infiltrates, with the infiltration coefficients i_j; v is the calculation speed of the outside air. $\sum$ **A** represents the sum of the additions (for the orientation, the cold surfaces' compensation and the special addition), and Δ **T** is the difference between internal temperature (T_i) and external temperature(T_e).

For a temperature difference of one degree, the relation (1) becomes:

$$q = K_{OS}S_S + K_{OF}S_F + Lq_i = q_S + q_F + q_i \qquad (2)$$

Considering, for example, a wall with a window having R_{OS}=0,92 m^{2}K/W, R_{OF} = 0,33 m^{2}K/W, the calculation speed of the outside air v = 4 m/s and the infiltration coefficient i=0,093W/(m/s)$^{4/3}$K (corresponding for timber double windows), for a total wall surface of 9,72 m^2 (3,60 m x 2,70 m) and diverse window sizes, **Table 1** presents the heat losses q_S, q_F and q_i , and their weight in the total heat loss.
We mention that the partial losses (q_S, q_F, q_i) aren't real losses, being obtained by multiplying by ΔT, but their weights are real.
Analysing the values in **Table 1** we find that the increasing of the thermal resistance of the opaque parts of walls with large windows is not enough . The increasing of the thermal resistance of the glass pane part , too , becomes obviously necessary.

S_s [m^2]	L_f [m]	H_f [m]	S_F [m^2]	L [m]	q_S [W/°C]	q_F [W/°C]	q_i [W/°C]	q 5+6+7 [W/°C]	$\frac{q_S}{q}$ [%]	$\frac{q_F}{q}$ [%]	$\frac{q_i}{q}$ [%]
9,72	-		-	-	10,57	-	-	10,57	100,00	-	-
8,28	1,20		1,44	6,00	9,00	4,36	3,54	16,90	53,25	25,80	20,95
7,92	1,50		1,80	6,60	8,61	5,45	3,89	17,95	47,97	30,36	21,67
7,56	1,80	1,20	2,16	9,60	8,22	6,54	5,66	20,42	40,25	32,03	27,72
7,20	2,10		2,52	10,20	7,83	6,82	6,02	20,67	37,89	32,99	29,12
6,84	2,40		2,88	12,00	7,44	8,73	7,08	23,25	32,00	37,55	30,45
7,92	1,20		1,80	6,90	8,61	5,45	4,07	18,13	47,49	30,06	22,45
7,47	1,50		2,25	7,50	8,12	6,82	4,43	19,35	41,96	35,25	22,89
7,02	1,80	1,50	2,70	11,10	7,63	8,18	6,55	22,36	34,13	36,58	29,29
6,57	2,10		3,15	11,70	7,14	9,54	6,90	23,58	30,28	40,46	29,26
6,12	2,40		3,60	13,80	6,65	10,91	8,14	25,70	25,88	42,45	31,67
5,67	2,70		4,05	14,40	6,16	12,17	8,50	26,93	22,88	45,56	31,56

***Table 1**: The partial thermal fluxes weight in the total flux in case of walls with diverse window dimensions.*

Conclusions

The conclusions that draw from the heat flow analysis are really important in establishing the necessary resistance of the closing elements. Therefore , we can see that the increase of the thermal resistance of the opaque part is less efficient in the case of walls with large windows and, hence , for obtaining a real efficiency of the thermal protection , the increase of thermal resistance for the glass paned parts also becomes necessary.
These considerations can lead to a few concrete ways of increasing the thermal transfer resistance efficiency for the glass paned parts of the walls. These are:

- -avoiding the use of simple windows for heated rooms;
- -using windows having better thermoinsulating qualities (thermoreflecting, IZOVIT), with the thermal transfer coefficient lower than the usual by 50 - 100%;
- -using, as an alternative to special windows, three or four glass sheets with air spaces of 15 - 20 mm between them;
- -improving the joinery design by using a metallic joinery with a reduced section and equipping it with thermal insulation, using supplementary thermoinsulating on the outline spaces, in the fixing part of the windows;
- -increasing the tightness of the joinery, thus, decreasing the amount of infiltrated air.