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# THE PRESENT SITUATION OF AIRTIGHTNESS AND THERMAL INSULATION OF WINDOWS AND THE PRACTICAL MEASURES OF ENERGY SAVING.

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(A Brief Report)

Gao Xi Jiu Tan Heng Yu

Institute of Building Physics Chinese Academy of Building Research, Beijing, China.

The problem of improving the thermal performance of windows has become a question of common interest. The reason is simple: heat loss by direct heat transmission and air infiltration through windows fixed on a normal apartment house may reach about a half of the total heat loss of the whole building in China. And the energy loss due to air infiltration through a window in common use in China is about 50% of the total loss of the window unit. Therefore the need to develop methods for estimating the heat transmission due to air leakage throubh the window has become apparent.

From 1978 to 1985, we carried out an extensive research work for the airtightness performance of windows. The result of the research are shown in Table I.

Table I The airtightness performance of the windows in common use in China

| Type | Parameters of airtightness ($m^3/mh$) $\Delta p=10pa$ | | |
|---|---|---|---|
| | Average | range | |
| | | min | max |
| The profile steel frame windows("Sh" type) (Single glazing) (No weatherstrips) fig. 1 | 4.2 | 2.4 | 7.5 |

| Type | Average | range min | range max |
|---|---|---|---|
| The rolled tubular steel frame windows("K"type) (single glazing no weatherstrips) fig.2 | 4.6 ~~4.7~~ | 2.2 | 6.2 |
| The airtightness steel windows (with weatherstrips) fig.3,4 | 2.0 | 1.4 | 2.7 |
| The aluminium sliding windows | 2.5 | 1.8 | 5.2 ~~6.2~~ |
| The aluminium casement windows | 0.5 | 0.3 | 0.8 |
| The PVC plastic windows | 1.1 | 0.96 | 1.3 |

The value of the coefficients of transmission of steel windows (included "Sh" and "K" type), shown in table 2, are the results of a systematical thermal testing work.

Table 2 K-value of steel windows($w/m^2k$)

| | |
|---|---|
| Normal Steel windows (Single glazing no weatherstrips) | 6.22 |
| *Two steel windows in series installation in the openings (double glazing no weatherstrips) | 3.34 |

*Note: This type of window is used in the vast severe cold regions.

Based on windespread investigtion, the practical measures of saving for windows are put forward as follows:

1. Improving measures of the airtightness performance of windows.

a. To raise the accuracy of window assemble process, to increase the lap length between closed sash frame and other frames.

b. To increase the space in the section of the joint of window frames.

c.To use the weasterstrstrips, the airtightness effe.ct shown in Table 3 is obuvious.

Table 3

| Type | section | (under 100pa) $m^3/mh$ | Force of operation | Durability |
|---|---|---|---|---|
| Neoprenene tubular Strips used for "Sh" type steel windows |  | 7.0 | higher | good |
| Neoprene angle Strips used for "K" type steel windows |  | 10.7 | higher | good |
| Neoprene Foam Strips used for "Sh" type steel windows |  | 1.4 | normal | normal |
| Neoprene Foam Strips used for "K" type steel windows |  | 1.3 | normal | normal |
| Polyvinyl Foam strips |  | 0.48 | higher | better |
| Polurthane Foam strips |  | 0.97 | normal | worse |

2. Improving measures of thermal insulation:

a. For the glazing area, beside to multinle the layer of glazing, the high infrared radiation reflectivity film, is used as the main method

b. For the metal frame, the non-metallic thermal break must be used in framing section. Table 4 shows the effectiveness of thermal break.

Tafle 4

| Type | The surface temperature ℃ inner surface | out surface |
|---|---|---|
| "K"type steel window no thermal break | -3.40 | -15.7 (Frost) |
| "K" type steel window with thermal break | -1.85 | -18.2 (nofrost) |

*Note: The testing conditions:

The in door temperature: +18 ℃

The out door temperature: -30 ℃

Useing the measures mentioned above in the competition of insulation windows design, sponsored by our research group, we had obtained several outstanding design schemes. After labratory investigation, we selected excellent designs as recommended window types. The constitution of the energy loss of the recommended window types are shown in Table 5.

Table 5 The constitution of the energy loss of windows

| Type | Thermal transmission heat loss QT(W) | Air infiltration heat loss QI(W) | QT/Q (%) | Total heat loss Q(W) |
|---|---|---|---|---|
| Steel windows (Single glazing no weatherstrips) K=6.4 (w/m²h) fig 1, fig 2 4. | 285 | 390 | 58 | 675 |

| Type | Thermal transmission heat loss QT(W) | Air infiltration heat loss QT(W) | QI/Q (%) | Total heat loss Q(W) |
|---|---|---|---|---|
| Steel windows (double glazing no weatherstrips) K=3.3 (w/m²h) | 145 | 272 | 65 | 417 |
| Steel windows (Single glazing with weatherstrips) K=6.4 (w/m²h) fig 3.4 | 285 | 202 | 42 | 487 |
| Insulation Steel windows No.1 (double glazing with thermal break and weatherstrips) K=2.88 (w/m²h) fig 5 | 129 | 33 | 20 | 162 |
| Insulation Steel window No.2 (double blazing with thermal break and weaterstrips) K=3.22 (w/m²h) fig 6 | 144 | 16 | 10 | 160 |
| Insulation Steel windows No.3 (double glazing +a layer reflective film; with thermal break) K=2.61 (w/m²h) fig 6 | 116 | ~~9~~ 16 | 12 | ~~130~~ 132 |

Note: The insulation windows: No.1 No.3 are the recommended windows.

The calculation condilions:

A12 strories apartmment house, in Beijing area.

The out door wind speed V=3m/s;

The ~~in~~ out door temperature: to=-1.9°C; The in door Temperature: ti=18°C

The indoor relative humidity i=60%;
The out door average humidity in the heating period $\varphi$=50%

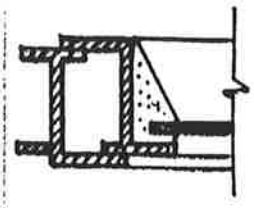


fig 1

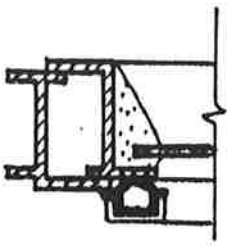


fig 3

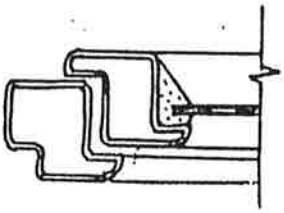


fig 2

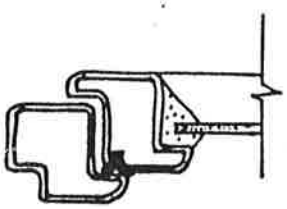


fig 4

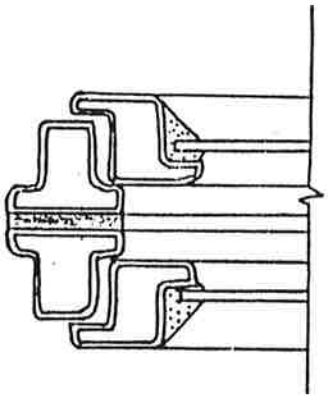
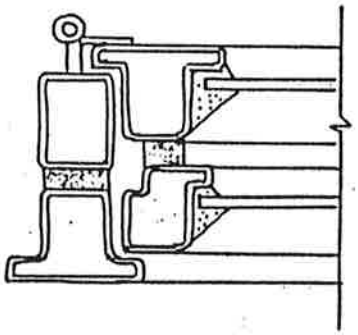


fig 5



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