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COMPARISONS OF RESISTANCE TO HEAT TRANSFER OF MODERN ENERGY-SAVING WINDOW STRUCTURES

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Annotation
This article is devoted to comparing the thermal conductivity resistance of conventional and modern energy-saving window panes.

Keywords. i double glazing, energy saving, light transmission, thermal conductivity, heat transfer resistance.

1. Introductions

Long-term research shows that the climate of Uzbekistan is sharply continental. Its peculiarity in hot dry weather in summer, rare precipitation, annual and daily temperature fluctuations is due to the fact that Uzbekistan is located far from the oceans, has no access to the seas, and air masses from the Atlantic Ocean come to the country hot and with little moisture. At the same time, the drying of the Aral Sea led to warming and a decrease in precipitation in winter.

Precipitation in Uzbekistan falls unevenly. Most of them are in the highlands, a smaller part - in the steppes and deserts. The burning sun and rare rainfall dry the air and the surface of the earth.

Summer in Uzbekistan is hot, actually starts from April and lasts almost until the end of October. According to Uzhydromet, in recent years in Uzbekistan, the average daily temperature has been around +43...+45°C, in the south (Termez) +47...+50°C, and in the evening it drops to +24...+28°C.

Given the climate change in Uzbekistan, the designers face the problem of maintaining the microclimate in the premises, while maintaining the architectural and artistic appearance of the building.

Currently, modern architecture requires the design of public buildings in the style of hi-tech and bionic. But in such buildings, mainly ordinary single-chamber double-glazed windows are used.

The most popular and common are single-chamber double-glazed windows with a thickness of 24 mm, with the formula 4-16-4 (the extreme numbers mean the thickness of the glasses, and the average means the width of the air chamber). Other single-chamber double-glazed windows are also produced with the following formulas:

16 mm thick (4-8-4), with heat transfer resistance R = 0.28 m^2 ^0C / W, sound insulation coefficient RW = 21 dB, weight (m) of such a double-glazed window is 21.7 kg per 1 m^2.;

The figures are given for double-glazed windows with standard (non-energy-saving) category M1 glass, chamber filling with dried air and an aluminum separating frame. The coefficients of light transmission and heat transmission for single-chamber double-glazed windows of different thicknesses are the same, 0.80 and 0.78, respectively. And this, with direct sunlight in the premises, will lead to a significant increase in heat in the room. This increases the consumption of electrical energy for air conditioning and consecration. Because when exposed to direct sunlight indoors, window blinds have to be closed. Which excessively sanctifies the premises and reduces the ability to work.

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The window is a heterogeneous structure, which includes materials with different R_{op}. To determine the total heat transfer resistance of the entire window, it is necessary to know R_{ref} and the area of each homogeneous zone.

As an example, let's take a single-leaf window with a width of W=1400 mm, a height of H=1000 mm, made of a metal profile with a total frame-sash width of Wp=113 mm. And heat transfer resistance R_{ref}=0.30 m^2S/W, using a single-chamber double-glazed window with air filling, sheet glass 4 mm thick, chamber thickness 16 mm, 4M1-16-4M1 having heat transfer resistance R_{ref}=0.32 m^2S/W.

$R_{ref} = \Sigma Fi / \Sigma (Fi/R_{oi})$

Where Fi is the area of the i-th homogeneous zone, m^2;

Roi - heat transfer resistance of the i-th homogeneous zone, m^2C / W.

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That is, to calculate the reduced resistance to heat transfer of the entire window R_{ref} of the window, we must know the resistance of each homogeneous zone and calculate the areas of all homogeneous zones.

In our case, we have two homogeneous zones:

1. Frame-sash area
2. Double-glazed area.

1. Calculate the frame-sash area.

F1=1,4 x0,113+1,4×0,113+(1-0,113*2)*0,113+(1-0,113*2)*0,113=0,491324 m^2

2. Calculate the area of the double-glazed window.

F2=(1,4-0,113*2)*(1-0,113*2)=0,908676 m^2

имеем:

F1=0,491324 m^2

R_o1=0,30 m^2C / W

F2=0,908676 m^2

R_o2=0,32 m^2C / W

Using the values of F1, F2, R_o1, R_o2 we calculate R_{ref} of the window

R_{ref} of the window = (F1 + F2) / (F1 / R_o1 + F2 / R_o2)=
(0,491324+0,908676)/(0,491324/0,30+0,908676/0,32)=1,4/(1,637747+2,839613)
=
=1,4/4,47736≈0,313 m^2C / W

Thus, despite the fact that the metal profile has R_{ref} = 0.30 m^2C / W, the total heat transfer resistance of the entire window turned out to be much lower

R_{ref} of the window=0,313 m^2C / W

For the second example, let's take the same metal profile with R_{ref}=0.30 m^2C/W, but at the same time using a 4M1-16-4M1 double-glazed window with heat transfer resistance R_{ref}=0.59m^2C/W.

F1=1,4 x0,124+1,4×0,124+(1-0,124*2)*0,124+(1-0,124*2)*0,124=0,503487 m^2

R_o1=0,30 m^2C / W

F2=(1,4-0,124*2)*(1-0,124*2)=0,866304 m^2

R_o2=0,59 m^2C / W

Using the values of F1, F2, Ro1, Ro2, we calculate R_{ref} of the window

R_{ref} of the window = (F1 + F2) / (F1 / R_o1 + F2 / R_o2) =
= (0,491324+0,908676)/(0,491324/0,30+0,908676/0,59)=0,440546 m^2C / W.

Thus, despite the fact that the metal profile has R_{ref}=0.30 m^2C/W, the total heat transfer resistance of the entire window turned out to be significantly lower than R_{ref} of the window=0.44 m^2C/W

Based on the calculations, we can make an unambiguous conclusion - the heat-saving properties of windows to a greater extent depend on the thermal properties of the double-glazed unit used.

Table number 1. Heat transfer resistance of 1 chamber double glazing

Glazing options	Reduced resistance to heat transfer R_{ref}.
4M-12-4M 1 chamber double glazing	0,30
4M-16-i4 1 chamber double glazing	0,59

Table number 2. Comparative description of the technical parameters of windows of the same design with different types of double-glazed windows.

chamber double glazing	One	one
Glass	Ordinary	i double glazing
Energy transmission, %	78	51
Heat transfer resistance R_o, m^2K/W	0,32	0,59
Holy Reflection, %	2	10
Holy pass, %	81	73
Soundproofing, dB	24	24

Conclusion

Based on the above examples and data, the use of modern double-glazed windows is more profitable than conventional double-glazed windows.

Modern double-glazed windows are more expensive than ordinary double-glazed windows, but they are much superior to conventional double-glazed windows both in terms of heat saving and light transmission.

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