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Study of Coatings of Residential Buildings in Climatic Conditions of Uzbekistan

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Abstract: The paper analyzed and considered the physical effects of the external environment on the formation of the temperature regime in the attic.

Keywords: temperature, outdoor environment, roof.

Today, the problem of energy saving is one of the most important factors in the operation and construction of residential complexes. In Uzbekistan, buildings and structures account for almost 45-50% (heating, ventilation and air conditioning systems) of total energy consumption. At first glance, one of the ways to save energy is to increase the heat-shielding properties of building envelopes.

In the hot climate of Uzbekistan, the roofs of buildings are most susceptible to overheating during the warm season, as a result of which the temperature in the attic can reach very high values and, as a result, the temperature in the apartments on the upper floors is far from comfortable. This is especially true for combined roof structures, when overheating of its inner surface has a negative impact on the microclimate in residential premises, which forces the use of air conditioning and ventilation systems.

In this article, we will consider one of the physical elements that, in interaction with the external environment, forms the temperature and humidity regime of residential and working premises, in particular, the attic space.

Outdoor radiation temperature tRH. and the temperature of the sky tsky are one of the physical quantities that determine the state of the external environment.

The effective radiation temperature that determines the interaction of the external environment with the building fences, in comparison with other physical parameters, is less studied.

The radiation temperature of the sky is a variable in time, depending on the state of the atmosphere, and the available methods for calculating it are very approximate, in which, as a rule, tsky is calculated indirectly through air humidity [3].

By direct connection with the measured meteorological quantities, it is possible to improve the calculated accuracy of the temperature of the sky. Such meteorological values are the temperature of the soil (soil) tgr and the effective radiation of the Earth's surface E = Ez - Ea (where Ez is the Earth's own surface radiation, Ea is the counter radiation of the atmosphere).

Applying the Stefan-Boltzmann law $f_t = \sigma T^4$, which determines the relationship between the energy flux f_t and the radiation emitted per unit area with temperature T (σ=5,6710^{-8} Дж·с$^{-1}$·м$^{-2}$·К$^{-4}$- the Stefan-Boltzmann constant), omitting intermediate calculations, we obtain an expression for the temperature of the sky:

$$t_{\text{неб}} = K_1 \cdot \left(K_2 - \sqrt[4]{E}\right) - T_o\,, {}^{\circ}\text{C}\,,\ T_o = 273{,}15\ \text{K}, \qquad (1)$$

Where $K_1 = \frac{11{,}473}{\sqrt[4]{\varepsilon_{\text{гр}}}}$, $K_2 = \sqrt[4]{0{,}06 \cdot \varepsilon_{\text{гр}}} \cdot \left(t_{\text{гр}} + T_o\right)$.

Based on the ratio [1] of the radiant heat transfer coefficient $\alpha_л$ of the surface located at an angle δ to the horizon:

$\alpha_л = 5{,}77 \cdot \varepsilon \cdot [\cos\delta + \varepsilon_{\text{гр}} \cdot (1 - \cos\delta)]$, (2)

Where ε, $\varepsilon_{\text{гр}}$ – emissivity of the outer surface of the fence and soil (soil), respectively.

The formula for calculating the external radiation temperature t_{RH} , taking into account (2), takes the form

$$t_{RH} = \frac{11{,}473}{\sqrt[4]{\left(5{,}77\varepsilon_{\text{гр}}\right)^{-1} \cdot \alpha_л}} \cdot \left(K_2 - \sqrt[4]{E \cdot \cos\delta}\right) - T_o\,. \quad (3)$$

In order to quantify the accuracy of the obtained relations (1) and (3), numerical calculations were performed for the soil temperature range from -30 to +90 ° C for various types of soil and various surface orientations relative to the horizon (Table 1).

Table 1Initial data for calculating the temperature of the sky and the external radiation temperature

soil type (soil)	Coefficient radiation я, $\varepsilon_{\text{гр}}$	Angle slope, δ	T emperature soil, °C
Asphalt Alumina Sand	0,93 0,80 0,76	15 30 45 80	In range -30 ÷ +90 in steps 5°C

Comparing with the measured data for ground temperatures of -25, 15, 35 °C, respectively, showed that the error in the calculated values according to formula (3) of the external radiation temperature is not more than 0.75 °C, and the temperature of the sky, calculated according to formula (1), is not exceeds 0.57°C.

The surface of the fence, exchanging radiation energy with the sky and with the surface of the earth so that half of the radiative component of heat losses falls on the radiative energy exchange between the fence and the sky, and the other half on the radiative energy exchange between the fence and the soil and other objects that have a radiation temperature t_z different from $t_{\text{неб}}$. The heat loss flux density from the fence surface can be written as

$$q = q_k + q_r = \alpha_к\,(T_c - T_{\text{нв}}) + \varepsilon \cdot \sigma \cdot (T^4{}_c - T^4{}_{\text{rz}}) \qquad (4)$$

The expressions are practically similar, but (4) compares favorably in that it explicitly contains the outdoor air temperature $T_{\text{нв}}$, which makes it possible to express the effective radiation temperature of the surrounding space as an explicit function of the air temperature. Taking into account the above, namely, for a separate building, heat losses are determined by the energy exchange between the fence and the sky and between the fence and the soil in the ratio 0.5 : 0.5, we write the radiation component q_r in the form

$$q_r = 0{,}5\varepsilon\sigma(T_c^4 - T_z^4) + 0{,}5\varepsilon\sigma(T_c^4 - T_r^4) = \varepsilon\sigma\left(T_c^4 - \frac{T_z^4 + T_r^4}{2}\right), \qquad (5)$$

taking the approximation T_z= $T_{нв}$, it directly follows

$$T_{rz}^4 = \frac{T_{нв}^4 + T_r^4}{2}. \qquad (6)$$

В конечном счете, с учетом (6), используя приближенную эмпирическую формулу T_r = 0,0522$\cdot$ $T_{нв}^{3/2}$, получаем расчетное выражение эффективной радиационной температуры окружающего пространства, как функцию наружной температуры воздуха:

$$T_{rz} = \sqrt[4]{T_{нв}^4 (0{,}5 + 4{,}642 \cdot 10^{-6} \cdot T_{нв}^2)}. \qquad (7)$$

In addition to the calculated radiation temperature of the outside air in accordance with formula (3), the dependence of the radiation temperature, as an explicit function of the outside air temperature, based on relation (7). The relations (7) adopted in the derivation are strictly inadmissible, since the difference in radiation temperatures calculated without the accepted approximations according to (3) and with the accepted approximations according to (7) is quite large. The above, as a rule, is ignored [1,2,3,4] when calculating radiation temperatures in order to obtain the thermophysical characteristics of enclosing structures in interaction with the environment. These differences are especially large in the region of negative temperatures. In the first approximation, depending on the type of soil, formula (7) can be used at appropriate temperatures, on average, exceeding +15 ÷ +20 ^{o}C..

Based on the performed numerical calculations, it can be seen that with a decrease in the soil emissivity, the values of the radiation temperature decrease, which, in fact, follows from (3).

Bibliography:

1. Анапольская Л. Е., Гандин Л. С. Метеорологические факторы теплового режима зданий. - Л.: Гидрометеоиздат, 1973. - 182с.
2. Кругликова А. М. Климат и ограждающие конструкции. – М.: Стройиздат, 1970. – 232с.
3. Строй А.Ф. Управление тепловым режимом зданий и сооружений. – Киев: Вища школа, 1993. - 153с.
4. Юров М. С. Термоизолирующее покрытие «Термо-Шилд» // Строительные материалы, оборудование, технологии XXI века, № 1(60), 2004. – С. 12 -14.
5. Щипачева Е.В., Рахимова Н. Б. Физическое воздействие наружной среды на формирование температурного режима чердачных помещений/ Материалы Республиканской научно-техн. конференции с участ.. заруб.ученых «Ресурсосберегающие технологии в железнодорожном транспорте», ТашИИТ, 2014.
6. Щипачева Е.В., Рахимова Н.Б. К вопросу повышения энергоэффективности жилых зданий/ Сборник научных трудов института «БашНИИстрой», Выпуск-79, Уфа 2016.
7. Щипачева Е.В., Шарипова Д.Т., Шаумаров С.С.. Тепловая защита зданий в климатических условиях Узбекистана.- Т., Монография: Muxammad Poligraf, 2019