UDC 697.92

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THE INVESTIGATION PARAMETERS OF ROOM MICROCLIMATE WITH AN INSTALLED THERMOSYPHON SOLAR COLLECTOR

In this article presents the results of natural experiments to determine the thermal power of solar collector. It was determined the efficiency of the proposed thermosiphon solar collector. Obtained empirical dependences for determining the amount of generated heat.

Key words: thermosiphon solar collector, air heating system, natural convection, absorbent surface.

Описано відомі методи встановлення сонячних повітронагрівачів. Наведено переваги запропонованого термосифонного геліоколектора у порівнянні з існуючими конструкціями нагрівачів. Опрацьовані дані, отримані експериментально, подано у графічному і емпіричному вигляді. Здійснено аналіз отриманих результатів.

Ключові слова: пасивний сонячний будинок, енергоощадність, термосифонний геліоколектор, мікроклімат приміщення.

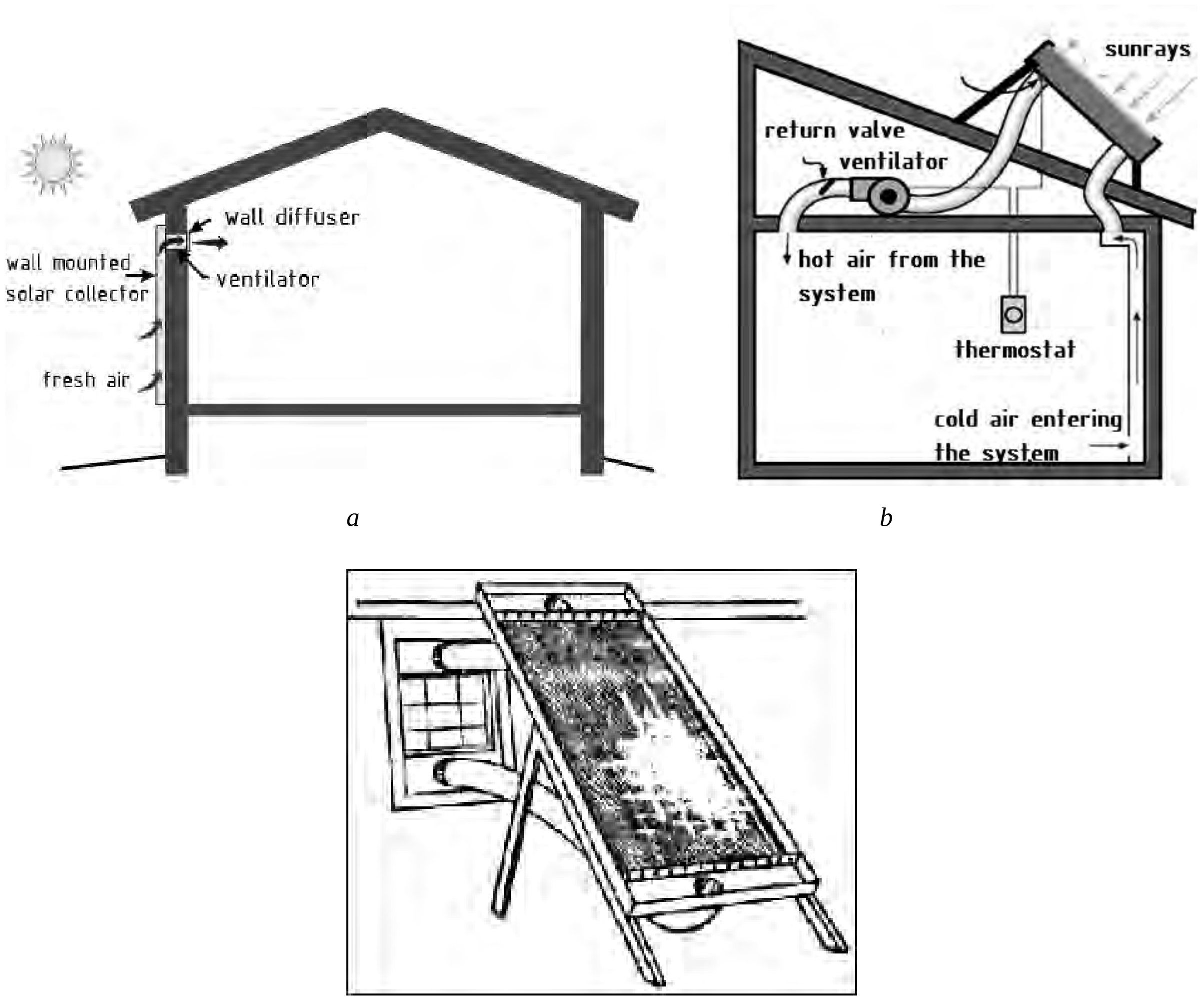
Introduction

The technology used currently in passive buildings are developed and implemented in the construction of the energy crises of the 70-s of last century. The result of accumulated experience in this area was the creation of Wolfgang Feist in 1996 "Institute passive house" in Darmstadt (Germany). Energy concept of energy saving building was designed to reduce energy consumption in new buildings at 8-10. Thus, ordinary house in Germany consumes from 150 to 250 kW • h. /$м^2$ per year, while as a passive house is enough only 10-15 kW • h./m^2 per year. Estimates properly designed passive solar house, in comparison with the traditional same area can reduce heating costs by 75% with a relatively small increase in cost of construction and materials [1,2].

In such buildings, premises heating is done by converting solar energy into heat. For this purpose, often using solar heaters. There are three basic methods of air heliocollector location: on the existing or slightly modified outer wall (Fig. 1a) or roof structures (Fig.1b), establishing heliocollector on the annex to the building (patio, garage) or in the yard (Fig.1c); on detached shed, garage or room, built exclusively to accommodate the solar collector.

Presented solar heating system can provide a partial heating of buildings, but have several disadvantages, namely, the loss of heat in the air ducts, the need for additional constructing support structures and so on. Therefore, the proposed system based on thermosyphon solar collector housing which is mounted in the roof structure. Input and outlet are located directly in a room heated. Details principle of the solar stove for heating air condition in the room described in [3]. The main difference of this design compared with known heliocollectors is the presence whirlwinds for turbulence air flow and the ability to use it as an architectural and structural elements of the roof of the house.

It is important to investigate the influence of solar air heaters for change of microclimate regime in the residential areas.



a *b*

c

Fig. 1. Options for installation of solar air heaters:
on the wall, b) on the roof, c) in the yard

The purpose and objectives of the study.

The work focused on the study the parameters of the room microclimate using a solar stove with variable heat flow intensity and area inlets and outlets of heliocollector.

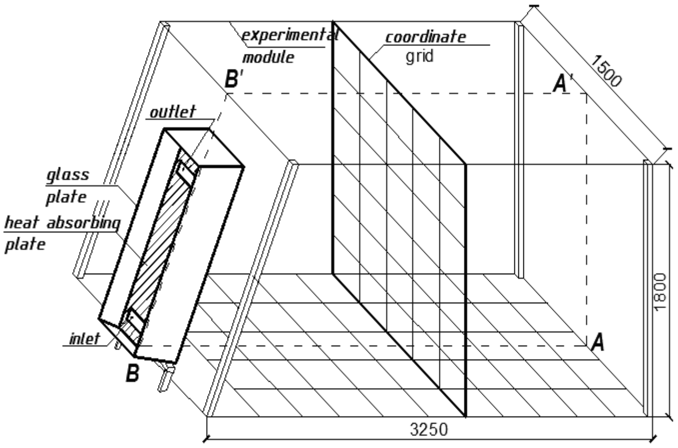
Experimental research.

To investigate the heating-air condition created by search thermosiphon heliocollectors, organized a series of the experiments for the experimental module with geometric dimensions (axbxh) 3,3 x1,5x2,3 m (Fig. 2).

Because the solar stove can be mounted in the roof construction, which is usually performed at an angle 45 ° or 60 °, Heliocolector installed in Research module also at an angle of 60 ° for maximal approach to real conditions. Volume of experimental space was divided into sectors with sizes 30h30x30 cm Variable heat flow ensured by infrared heaters with power regulator.

Experimental research were carried out as follows:

Corps of solar collector is installed in an experimental module at an angle of 60 °, inlets and outlets of heliocollector are located directly in the experimental room. Heat flow passes through the glass plate, absorbed by heat plate, it converts solar energy into heat. Sunny air stove works on the termosyphonesie principle: cold air from the room through the inlet enters the solar collector, washes the absorbing heated plate goes up and warmed back to room through the outlet. Unisothermal stream arising from solar collector partially mixed with cool air from the room and rises.



a *b*

Fig. 2. Scheme (a) and photo (b) of experimental module

Using the hot-wire anemometer ATT-1004 were determined the temperature and air velocity in the inlet and outlet of heliocollector and in the volume of the module. To calculate the heat losses of solar collector`s corps were determined temperature of the absorber plate and the glass plate with the help of pyrometer Nymbus-530. The intensity of the heat flow determined by piranometr.

The experiments were carried out by variable coolant flow rate and intensity of the heat flow, which ranged from 155 W/m^2 to 850 W/m^2. Air consumption changed by adjusting the area of inlet and outlet of solar air heater and varied in the range from 11.3 m^3/hr. to 59 m^3/hr.

The results of research.

Based on the experimental investigations were constructed a graph of dependence the power of thermosyphon solar collector, Q, W, changes in the area of inlet and outlet of air heater, F, m^2, and heat flow intensity I, W/m^2 (Fig. 3).

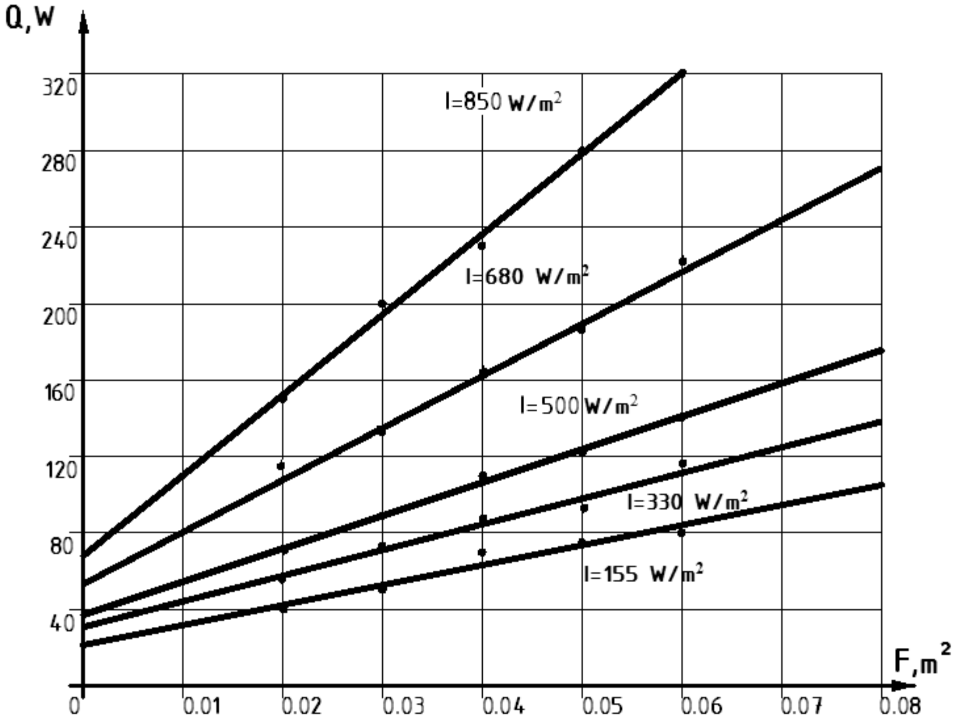


Fig. 3. Dependence the power of thermosyphon solar collector, Q, W, changes in the area of inlet and outlet of heliocollector, F, m^2, and the intensity of heat flow, I, W/m^2

The fig. 3 shows that the maximum power of solar collector available at the holes of heliocollector with an area equal to 0,063 m^2. The maximum amount of heat received by the solar heater, observed in the intensity of heat flow 850 W/m^2 and square apertures 0,063 m^2 and is 320 W. Based on the experimental data, a number of empirical relationships, to find the heat capacity. Linear dependence nomogram was functionally described by the matrix method [4] using the computer program GRAPHER and reduced to one equation:

$$Q = 10{,}3 + 0{,}059 \cdot I + (-22{,}7 + 4{,}8 \cdot I) \cdot F \text{ ,W.} \tag{1}$$

Fig. 4 shows the typical dependence of heliocollector`s power, *Q*, W, from the temperature difference of cold air in the experimental modules and heated air after heliocollector, *Δt*, ° C, and it`s volumetric flow rate, *L*, m^3/hr.

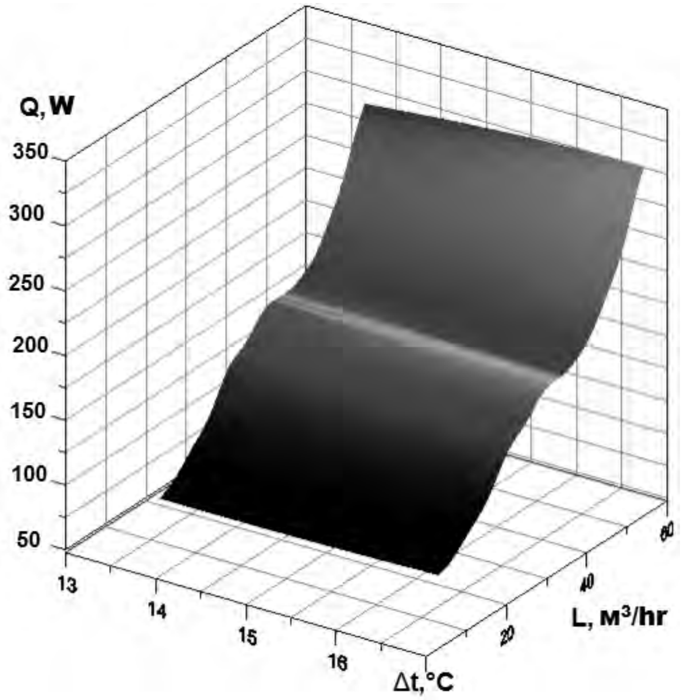


Fig. 4. Dependence the power of thermosyphon heliocollector, Q, W, from the temperature difference of cold air in the experimental modules and heated air after heliocollector, Δt, ° C, and it`s volumetric flow rate, L, m^3/hr

When air flow rate equal to 59 m^3/hr. the heat carrier heated the air maximum at 17° C. In work [5] indicated that passive solar stove can be considered effective if it heats air at 17° C and above. It should be noted that the experimental thermo heliocollectors, with an area of 1.2 m^2 absorbing plate, fully supports heat-air mode at room 11m^3/hr. volume.

Conclusions

Presents the results of experimental studies changes in microclimate parameters in the experimental modules installed thermosyphon heliocollector. Reaeached the nature of the change of air heater`s power in regulating of its holes area and intensity of heat flow.

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