SOLAR HEATING SYSTEMS FOR BUILDINGS

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Annotation. The article discusses the use of passive solar heating systems as a system solution that increases the energy efficiency of a building. It is noted that the most common passive heating system is the heating of an insulated glazed volume; the design, features and advantages of a solar greenhouse are described.

Key words: solar heating, passive systems, solar greenhouse, solar house, solar heating, energy efficiency.

There is nothing new in using the Sun as a source of heat. Even 2400 years ago, Socrates wrote: “Now in houses facing south, the sun's rays penetrate into the galleries in winter, and in summer the path of the sun lies above our heads and above the roofs so that there is shadow. If then this is the best arrangement, then we will have to build the southern facade of the house higher, so that the rays of the winter sun enter the house, and the northern facade lower, in order to protect the house from the winter winds.”

While the Greek house described by Socrates lost heat as quickly as it gained it due to convective and radiation losses, the Romans discovered that if the portico (gallery) and south-facing windows were glazed, then solar energy would be captured and could be stored heat received for the night period. This simple phenomenon is called the “greenhouse effect.” Today, a house that uses the greenhouse effect for heating is what we call a “passive solar house.”

The concept of a passive house originated almost 30 years ago in Germany, where the first passive house projects were later developed and implemented, showing their profitability. Since then, the passive house standard has become increasingly popular in many countries.

The architectural concept of a solar house is widely known, and can be briefly presented as follows: The space of the eco-house, protected from the wind and open to the sun, is formed by a windproof horseshoe wall facing south, collecting the sun's rays, and a canopy - roof, providing shade from the high summer sun.

The shape and finishing materials of the inner surface of the wall should contribute to the concentration of solar rays, or their absorption to warm up thermal masses - heat accumulators, at low winter solstice. By separating the internal space of the “horseshoe” from the south from the external environment with selective stained glass, we use the greenhouse effect. The thermal mass (a stone wall behind glass, a floor or a massive fireplace under a skylight), while retaining solar heat, should provide comfortable indoor temperatures at night.

On the windward side, the wall and roof of a solar house can be turned into a green hill or covered with forest, which will protect against the cold northern monsoon. Summer

shading of the southwestern and western sectors of the horizon will be provided by external green screens of lianas. Aeration during overheating and soft natural light - ridge windows on the roof, with an influx of cool air through the openings at the base of the stained glass.

Heating of an insulated glazed volume is a type of direct solar heating, differing from the first in that a non-residential, unheated room is heated by the sun's rays. This room is either adjacent to the southern facade of the building or built into it, called a solar greenhouse or "sun space" - solar space. In summer it can be used to expand the living space.

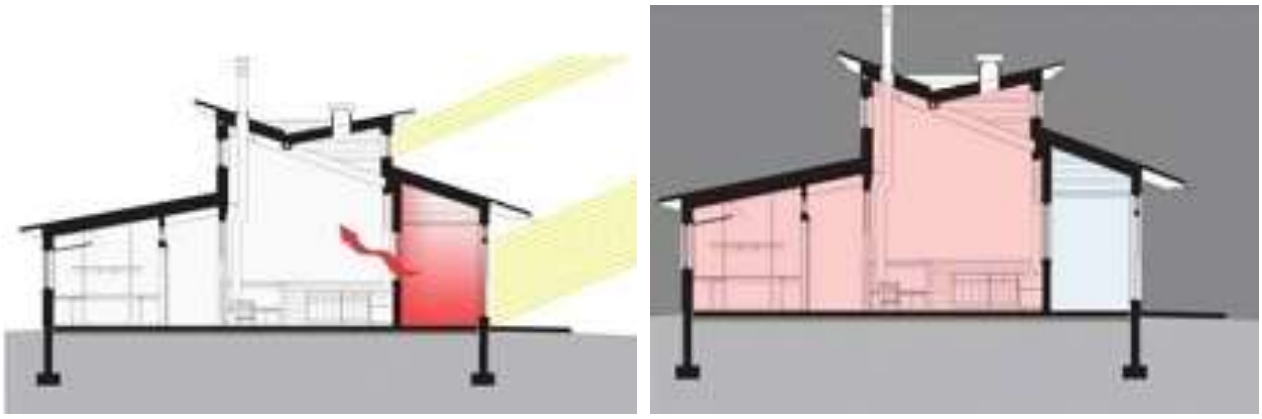

Fig.1. solar greenhouse: day and night

The main task of a solar greenhouse is to heat the air in it, thanks to the large glazed surfaces. Next, the heated air is distributed to the rest of the rooms either naturally or with the help of forced ventilation activated by a sensor system when a certain air temperature in the greenhouse is reached.

This solar heating system undoubtedly has a number of advantages compared to the previous one, since the flow of heated air into living spaces can be controlled.

Therefore, this type of solar heating has become widespread when designing low-rise residential buildings. This solar heating system is without a doubt the most important, as it greatly influences the appearance of the building and the internal organization of the house.

The main advantages of this passive solar heating system for a house are: the ability to control the flow of heated air into the living areas of the house; use of seasonal zoning (in summer the solar greenhouse can be used as a recreation room, and in winter as a heating system); the presence of non-residential space in which the air is heated before entering the residential premises of the house; creating a buffer zone (usually green) between nature and the interior space of the house. Heat accumulation in a solar greenhouse occurs in the walls, floors or fireplace.

The required glazing area in a solar greenhouse, necessary to maintain comfortable conditions in the house, depends on the outside air temperature in the area where the house is located (average values for January and February), and the material in which heat is accumulated.

From a technical point of view, houses that use heating of an insulated volume can be divided into 4 groups:

1) semi-direct heating from solar space;

2) indirect heating from solar space;

3) thermosiphon system with solar heating;

4) circulation of warm air around the house (houses with a "double shell").

In the first group, the air heated in the solar greenhouse enters the living quarters, where excess heat accumulates in the walls and floor. In the second, warm air in the solar greenhouse heats the massive accumulating wall and floor of the room, after which the heat enters the living space. In the third group, heated air from the solar greenhouse and cool air from the living room circulate through holes in the insulated wall. Excess heat accumulates in the walls and floor of the living room. The fourth group includes houses that have a "double shell". On the south side, in the space between the shells there is a sunny space in which the air is heated, then it is distributed throughout the entire intershell space, heating the living spaces.

Solar houses differ from all others in their architectural expressiveness, overcoming the utilitarianism of architecture and schematism. In essence, a solar house is a low-rise house of a new generation, characterized by environmental efficiency, individual appearance and a high architectural and aesthetic level.

Unfortunately, the issue of architectural solutions for solar houses with the passive use of solar energy remains poorly understood, despite the variety of scientific and design works. However, taking into account the obvious advantages of a passive home heating system: energy efficiency, the ability to control the flow of heated air into the living areas of the house; use of seasonal zoning; presence of non-residential space; creating a buffer zone between nature and the interior of the house - we can say with confidence that a solar house with a solar greenhouse will be appreciated.

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