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TÍTULO: Sistema de energía solar para calefacción y suministro de agua caliente doméstica con bomba de calor conectada en términos de ventilación fotovoltaica.

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RESUMEN: En este documento se discute un sistema básico y central, que está en línea con los sistemas diseñados para usar energía solar. La investigación actual se utilizó para suministrar calefacción por suelo radiante y agua caliente utilizando energía solar; por lo tanto, al reducir la temperatura del agua caliente que devuelve el suelo radiante, el sistema de calefacción puede aumentar el rendimiento de la caldera. La energía solar no puede utilizarse directamente para la calefacción por suelo radiante, aunque el sistema fue diseñado para este propósito en áreas residenciales y comerciales.

PALABRAS CLAVES: energía solar, colector solar, calentadores de agua con bomba de calor, colector de calor fotovoltaico.

TITLE: Solar energy system for heating and supplying house hot water with heat pump connected in terms of photovoltaic ventilation.

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ABSTRACT: A basic and central system is discussed in this paper, which is in line with systems designed for using solar energy. The current research was used to supply underfloor heating and hot water using solar energy; so, reducing hot water temperature returned by underfloor, heating system can increase the boiler performance. Solar energy cannot be directly used for underfloor heating, although the system was designed for this purpose for residential and commercial areas.

KEY WORDS: solar energy, solar collector, heat pump water heaters, photovoltaic heat collector

INTRODUCTION.

Energy is one of the primary sources of human activity in all parts of life and osteoporosis of human activities. The importance of energy is undeniable given the strong relationship between energy and economic activity. Old fossil fuels were early sources of energy as solid phase such as wood and coal. From the 5th century onwards, most of the energy used by human beings came from these sources [1].

An increase in overall energy demand due to population growth as well as the industrial revolution of the 19th century pushed fossil fuels to phase change, and saw the liquid phase of refined fossil fuels ahead. Oil is much more effective and practical than wood and coal. Energy, especially oil, was considered as a blood vessel in the economic life of various countries of the twentieth century [2].

Recently, the world is familiar with the gas phase of fossil fuels which are even more useful. Fossil fuels make up about 2 percent of the world's energy consumption, of which 1.5 percent is allocated to oil, 1.5 percent to coal and 1.2 percent to natural gas [3].

Solar energy is mainly used in two types of systems: thermal systems and photovoltaic systems. In thermal systems, solar radiant energy is converted to thermal energy. But in photovoltaic systems, solar radiation energy is converted into electricity.

The two systems can be combined to form a thermal photovoltaic system. Among all types of photovoltaic cells, polycrystalline silicon typically converts about 2% to 7% of impact radiation into electrical energy [4].

However, as the photovoltaic temperature decreases, this amount of energy decreases, and there is a reverse relationship between the efficiency of the photovoltaic system and its temperature [5].

Iran is located in a solar belt with more than 6 days of sunshine in most places and regions. Therefore, in countries such as Iran where average solar radiation reaches 2 kW / m 2, in many places it exceeds 6 hours per year and in some places, it can exceed 2 hours. So, solar energy is not only necessary but also inevitable [6].

In order to optimally use energy in the house, solar energy has always been a key option and is therefore widely used in hot water supply. Recently, hydraulic underfloor heating systems are often used in a residential building as a method of providing adequate heat energy in a building [7].

Both underfloor heating system and the hot water supply system need hot water which requires solar energy to increase the temperature. In this research, simulation is performed with TRANSYS software which compares the results of simulation with the results of experimental observations. Usually, the performance of the underfloor heating system and the house hot water consumed and the efficiency of the boiler depends on the elements such as inlet water temperature, tank volume and how the tank is insulated. In this study, a system is investigated which uses solar energy directly to supply underfloor heating energy.

But the question is how to make the most of solar energy? Should this energy be used only for underfloor heating or should this energy be used for a water tank to increase the water temperature of the tank for the water consumed of the building? These are some of the questions which will be reviewed in this research.

DEVELOPMENT.

System description.

A basic and central system is discussed in this paper. This system is usually in line with solar systems designed for using the solar energy (Fig. 1). During the time, underfloor heating system operates, the solar energy system only provides the energy required for the underfloor heating system as long as the average temperature of solar collectors is higher than that of the underfloor heating system, but when underfloor heating system goes out of the circuit, the solar system is used to heat water inside the tank (Figure 1).

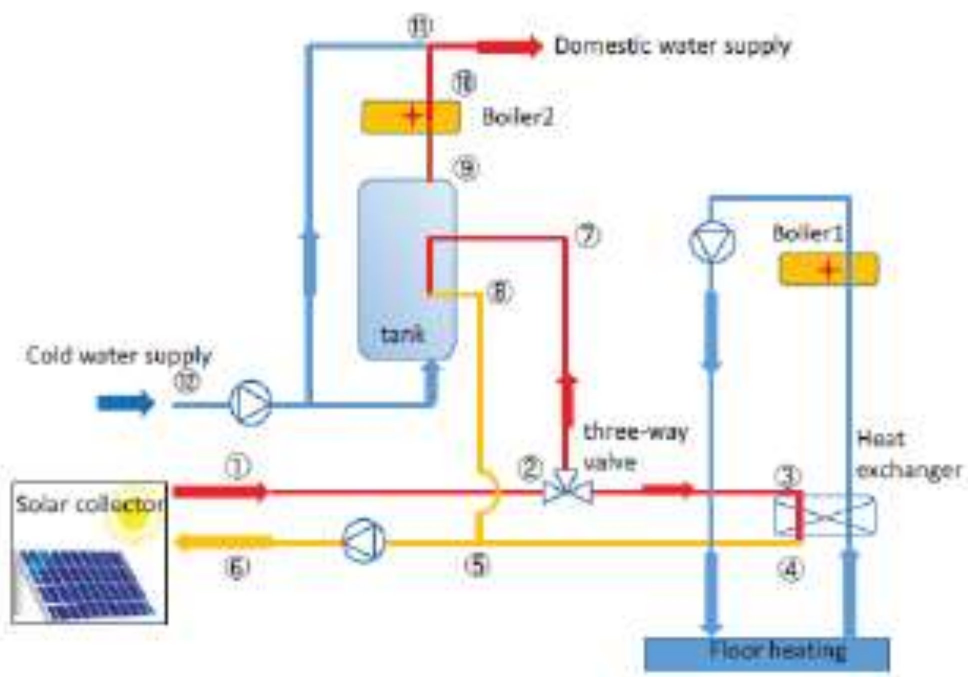

Figure 1: Solar energy is used for underfloor heating only, and when the system is out of circulation, solar energy is used to make the necessary heating for hot water consumed by the tank.

Data and methodology.

Calculation of the Building Heating Load.

In calculations of heating energy consumption annually, the main parameters are heating transfer coefficient and inertia of the building, if one wants to determine the heating transfer rate with high accuracy, it is necessary to perform the building operation in unstable state taking into account changes in climatic parameters of temperature, humidity and calculate the radiation at different times of the day. To simulate a residential building in Tehran, environmental conditions in TRANSYS software is simulate. Then, in the TRNBUILD section of the software, the heating load of the building is determined by selecting the wall materials and the type of windows.

The desired building is a main building (10 meters by 10 meters by 3 meters). There are four exterior walls to the four sides and windows to the south, west and east with an area of 6 m^2, 3 m^2 and 3 m^2. The amount of heat generated by people, equipment and lighting is considered to be 2 KW, 1.2 KW and 2 KW respectively. The building is intended to be a commercial building that operates daily from 8:00 am to 6:00 pm. The building is supposed to have three air changes per hour. The analysis is for November to April.

The outer walls are 35 cm thick with the following layers: 1.5 cm plaster, 12 cm brick, 8 cm insulation, 12 cm brick and 1.5 cm plaster. The ceiling is 31.5 cm thick with the following combination: 20 cm cement, 10 cm insulation and 1.5 cm plaster.

The ground floor is 40 cm thick with different layers of cement and insulation material and heating transfer (U) is 0.31 W/m2K. Exterior walls, ceilings and windows have heating transfer values of 0.440 W/m^2K, 0.36 W/m^2K and 1.4 W/m^2K, respectively.

The last important information to fully determine the building is the thermal properties of the building materials. Table 2 provides information on thermal conductivity, specific heating capacity and density used. The building heating load is easily calculated by TRNSYS and depends on the temperature inside the building. In this study, 22 ° C was selected as the optimum indoor temperature to achieve the usual thermal conditions.

Table

Aggregate	Thermal conductivity coefficient (W / m.K)	Specific heat capacity (J / Kg.k)	Density (Kg / m3)
Brick	0.85	1000	1800
Plasture	1.4	1000	2000
Insultation	0.04	800	40
Cements	2	800	2400

1. Thermal properties of building materials.

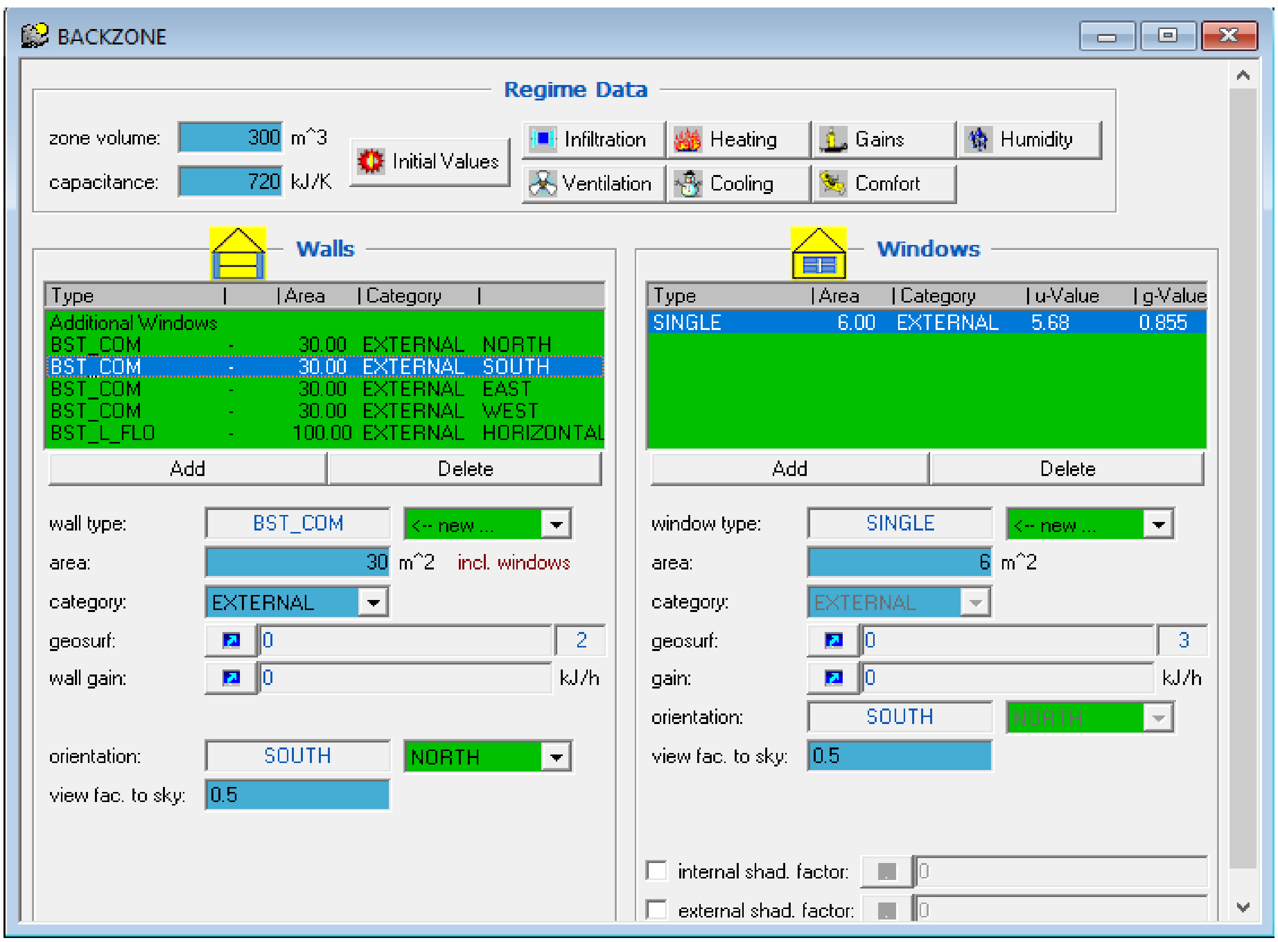

Figure 2. Data entered for the building in TRNBUILD.

Results.

Solar System Simulation.

The simulation of the solar system with a photovoltaic collector is performed with the TRANSYS software which is shown in Fig. 3.

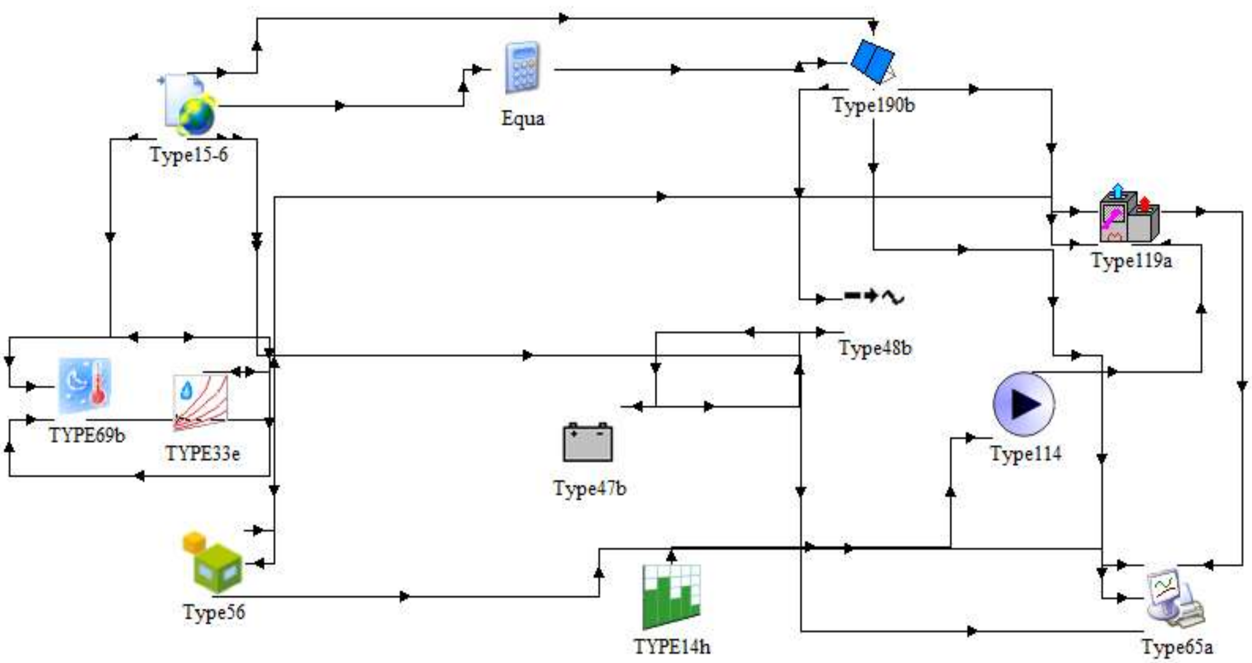

Figure 3. Solar System Simulation in TRANSYS Software.

Simulation results.

The amount of energy consumed by the system is shown in Fig. 4. In terms of the amount of underfloor heating energy for the system in question, it is assumed that solar collectors in the underfloor heating system are fully utilizing their energy, while the results indicate that all solar energy in the hot water source is reduced. The energy consumed is used. This result can be seen objectively using Figure (5).

In fact, figure (5) shows the temperature of the solar panels outflow water and floor heating on a given day with sufficient sunlight on the other hand because the floor heating system is active from 1 to 5 hours per day lower than the solar panel outlet temperature. From the water temperature the outlet is from underfloor heating system. Also, when both solar energy and hot water are transferred from underfloor heating to floor tanks, the temperature can be easily adjusted. Of course, when hot water is not consumed, the pump does not work in this case, so solar energy is not fully collected as the temperature of the tank is high and no use of stored water is possible, so compared to the first system. It has high heat dissipation.

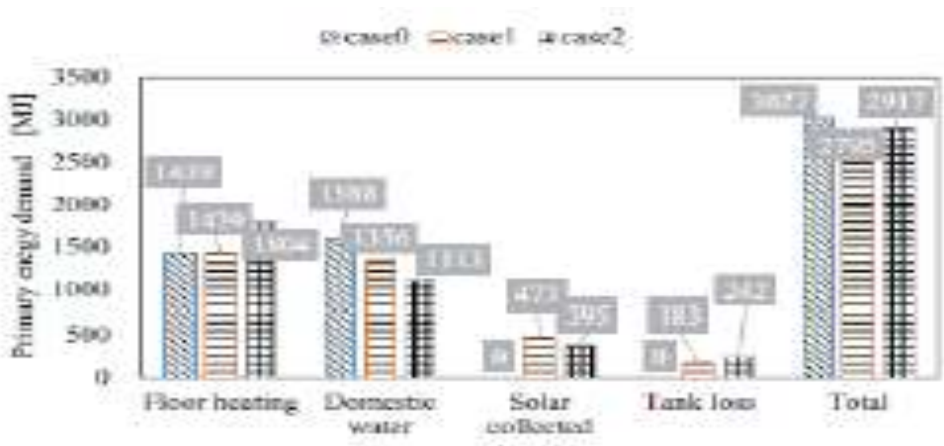

Figure 4: Energy consumption in 3 different cases.

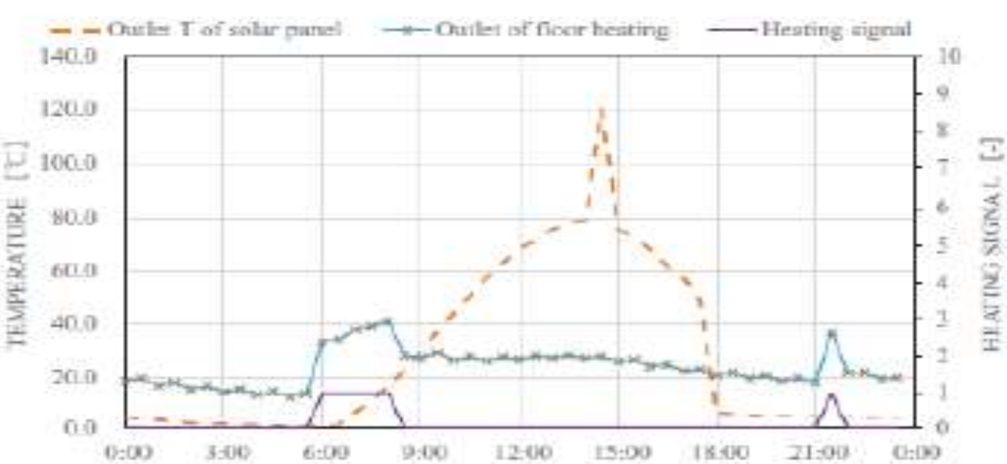

Figure 5: Solar panel water temperature and underfloor heating system.

CONCLUSIONS.

Considering this fact, that the system used in the current research, a system was used to supply underfloor heating and hot water using solar energy, reducing the hot water temperature returned by underfloor heating system can increase the boiler performance but simultaneously in cases where the tank volume sufficient storage can cause solar energy loss. In other terms, solar energy cannot be directly used for underfloor heating, although the system was designed for this purpose, especially for residential and commercial areas. In this case, the natural temperature is high on sunny days and the solar system can receive a lot of energy, while underfloor heating system needs as well as on the cold days the radiation intensity is low but there is a great need for floor heating.

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