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A Review on Performance Analysis of Earth-Air Heat-Exchanger for Year-Round Air Conditioning

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***Abstract* - An abstract is a brief summary of a research article in one paragraph, this is the emerging technique which reduce the cooling and heating loads of buildings in winter season and as well as in the summer season. And thus reduce the overall energy consumption in that particular place of installation like buildings, hospitals, schools, colleges etc. It is a geothermal energy (renewable energy). In this system we should focus on the effect of soil characteristics such as moisture content, density of soil, and type of soil on the thermal performance of EAHE system. And the main parameters to be considered in EAHE system is velocity of air, mass flow rate of air, depth of pipe and material of pipe. The effect of the working parameters such as pipe material, pipe length, pipe diameter, depth of burial of the pipe, air flow rate and different types of soils on the thermal performance of Earth-Air Heat-Exchanger (EAHE) systems is very crucial to ensure that thermal comfort can be achieved.**

Keywords: Earth-Air Heat-Exchanger; Hot summer and cold winter; Thermal performance; Renewable energy.

I. INTRODUCTION

Energy is one of the major inputs in the economic growth of a country but energy saving is one of the major challenges in today's world. Our concern is to minimize the use of high-grade energy and to promote the use of renewable energy. Out of the world's total energy demand, renewable energy sources (RES) supply up to 14%. Renewable energy includes biomass, geothermal energy, hydropower etc.

In developing countries energy sector is considered as a crucial sector, the demand for consumption is increasing than its production. India consumes more energy in residential, commercial and agricultural sectors than China, Japan, Russia etc. the consumption of energy in buildings has significantly increased in the last decade. In order to improve the energy conservation in building it has been recommended to use energy audit in buildings while construction.

EAHE may be utilized in place of typical air conditioning. When it's hot outside, the EAHE evaporative cooling hybrid system may be put to greater use. In present study, transient analysis of Earth–pipe–air heat exchanger (EPAHE) has been done using FLUENT.

1.1 Earth Tube Heat Exchanger

Devices that utilize the ground as a wellspring of or sink for warming or cooling are called ground-to-air heat exchangers, ground pipe heat exchangers, or soil heat exchangers. Numerous concepts and experiments with EAHE have so far been developed and tested to determine the best parameter values to increase performance based on location and other variables.

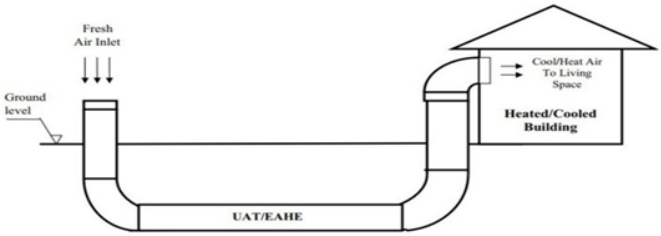

Figure 1: Open circle for space warming/cooling framework

1.2 Open Loop

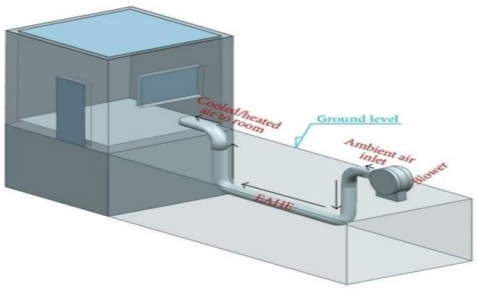

Figure 2: open loop system

II. METHODOLOGY

Thus, at a sufficient depth the soil temperature is lower than the outside air temperature in summer and higher in winter. When the fresh air is drawn through the earth tube heat exchanger the air is thus cooled in summer and heated in winter. In combination with other passive system and good thermal design of the building, the earth air heat exchanger can be used to preheat air in winter and avoid air conditioning

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units in building in summer, which result in a major reduction in electricity consumption of a building.

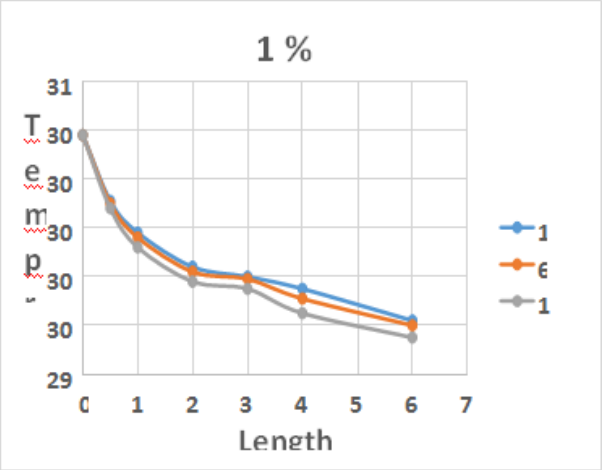


Figure 3: Comparison of EATHE system for 10% wet system

2.1 Earth to Air Heat Exchanger in Arid Regions

During the day and the summer period in Fig.7, the outdoor air temperature Texit is higher than the temperature of the subsoil T soil. The air is pulsed naturally (by prevailing winds) or mechanically(by fan) inside the buried tube where it exchanges heat with the surrounding layer by conduction and convection where ground works as sink source and air loses some degree during its passage.

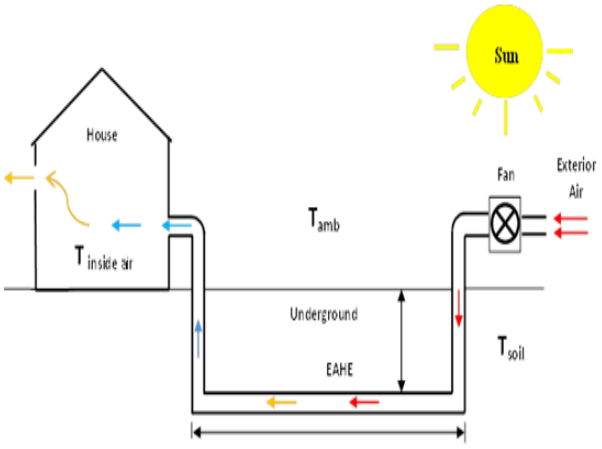


Figure 4: Air-ground heat exchanger in operation during the day and summer period

2.2 Experimental Setup of EAHE with water jacket

Ground earth air heat exchangers are the emerging technique which reduce the cooling and heating load of buildings in summer and winter season and thus reduce the overall energy consumption in a building.

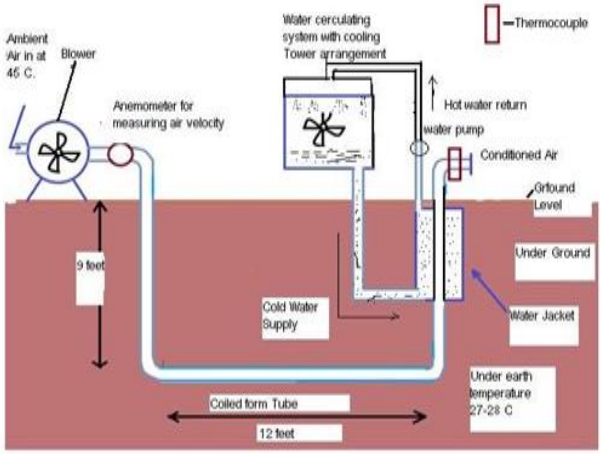
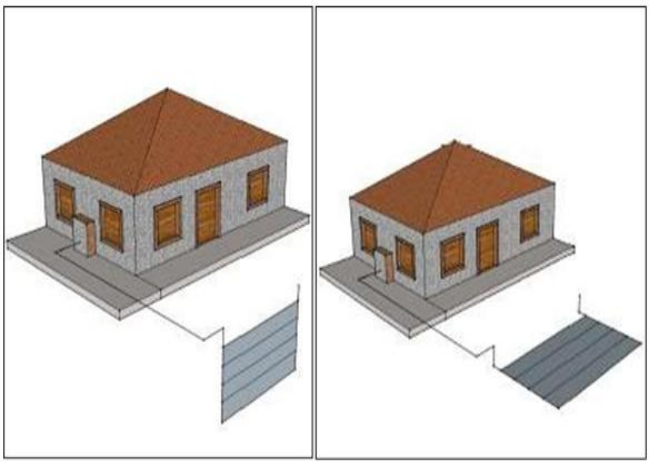


Figure 5: Experimental Setup of EAHE

2.3 Geometric dimension and design of the EAHE pipe system

Geometric dimension and design of the EAHE pipe system also plays a big role in determining the thermal performance of the system. As shown in Fig 6 shows the arrangement of piping system of the EAHE.



(a) **(b)**

Figure 6: (a) -Vertical earth piping cooling VEPC system, (b) - Horizontal earth piping cooling HEPC systems

III. RESULTS AND DISCUSSIONS

A deep understanding of EAHE system is essential for its design and application in hot summer and cold winter areas.

The effects of inlet air temperature, pipe length and operation time on the thermal performance were evaluated and described in this section. The change of underground soil temperature around the pipe along with time was also studied.

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IV. CONCLUSION

A deep understanding of Earth-Air Heat-Exchanger (EAHE) system is essential for its design and application in hot summer and cold winter areas. This can be concluded that the earth's undisturbed temperature remains always higher than that of ambient air temperature in winter and vice versa in summer. To utilize efficiently the heat capacity of earth EAHE system is to be designed.

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