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Earth Tube Heat Exchanger

Siddhanth Kumawat, Ghanshyam Khatik
Arya Institute of Engineering and Technology, Jaipur (India)

Abstract: Devices that utilise 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. In this study, we will review the studies conducted so far from the viewpoint of performance evaluation considering the influence of various parameters such as construction materials, depth from the ground surface, wind speed, and pipe length.

I. INTRODUCTION

At a given depth from Earth's surface, it's known that the ground is chilly in summer, but hotter in winter than the surrounding air. Using ground temperature gradients for both cooling and heating purposes [1] may be an option for future study. In light of the limited energy resources available, it is basic to distinguish elective energy sources in order to preserve conventional fuels for the future and save space. It is thought that ground- to-air heat exchangers are a reasonable choice to warming or cooling structures. Metal, plastic, or substantial lines are covered at a specific profundity in the earth to serve as conduits. Fans are used to circulate fresh air through the pipes. Inside the pipe, heat may be moved from the beginning the air contingent upon the temperature differential. To get the most performance out of the system, it has to be well-designed. Therefore, the cross-sectional size and kind of pipe, wind speed, and soil condition all have a significant effect in the system's efficiency. In order to reduce pollution and conventional energy usage, use environmentally friendly, renewable sources of power. Ground-to-air heat exchanger systems may be divided into two primary categories.
Earth tube heat exchanger of the open style
Earth tube heat exchangers with a closed design

A. Open System

It is shown in Figure 1 that preheating or precooling air travels via pipes buried under the ground before being warmed or cooled by a standard cooling framework before it enters the structure.

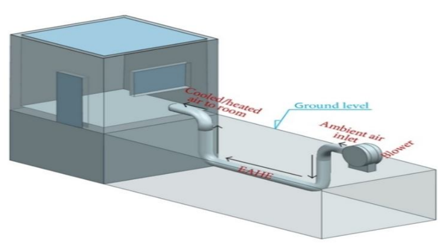

FIG.1: open loop system

B. Closed System

To move heat from the ground to the air, an intensity move medium is circled through the intensity exchanger in Figure 2, which may be horizontal or vertical depending on site conditions.

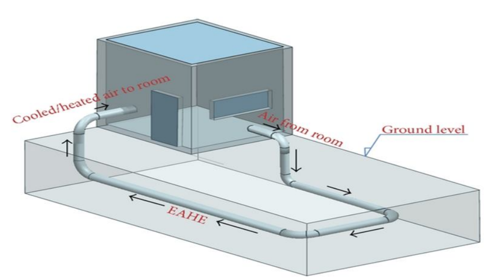

FIG. 2: closed loop system

EAHE may be utilised in place of typical air conditioning. When it's hot outside, the EAHE evaporative cooling hybrid system may be put to greater use. EAHE's thermal performance improves as the soil's thermal conductivity increases. Raising the length of the buried pipe, lowering its diameter, reducing the mass flow of air through it, and increasing the soil depth to 1.5-2 m all help increase EAHE performance. [2]

II. METHODOLOGY

The so-called "Earth-to-Air heat exchanger" Houses and other structures that have air intakes are linked to the EAHE system via a lengthy underground conduit made from metal, plastic or concrete. During the winter, a pipe-mounted fan forces the atmosphere to move, transferring heat from the hot ground to the cold air, and during the summer, moving heat from the cold ground to the hot air. Let me. Pipe outlets are installed in places that require air conditioning, such as industrial buildings and livestock buildings. By using this free energy, the energy consumption of indoor air conditioning can be reduced, which is a very convenient method.

A. Open Loop Systems and Closed Loop Systems

Open loop systems provide the building with fresh air, whereas closed loop systems circulate the conditioned air inside the structure and are thus more efficient than open loop. [3]

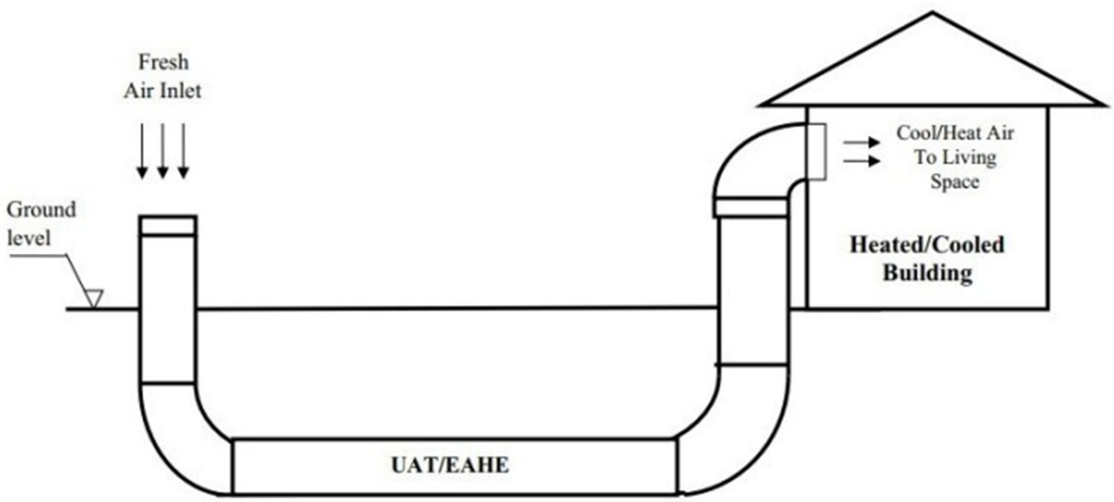

FIG.**3 Open circle for space warming/cooling framework [3]**

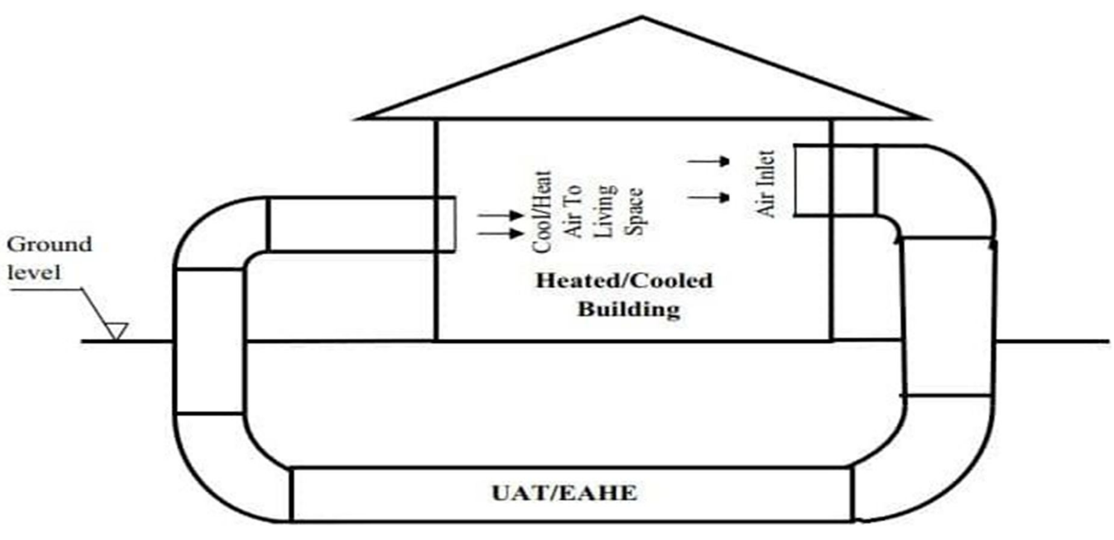

Figure 4: A closed loop system for room heating and cooling [3]

B. ETHE Effects of Various Parameters

1) Material Effect: In the beginning, ETHE was built using steel pipes, but after that, numerous kinds of materials were experimented with. According to research [4,5], PVC materials have the same impact. Because of this, PVC may be used in place of more expensive materials, and the product will last longer. A slight difference in air temperature at the pipe outlet between steel and PVC may be attributed to the better conductivity of steel.

2) Effect of Velocity of Air inside Pipe: Researchers tested the impact [4,5] and found that increasing the air velocity from 2.0 to 5.0 decreased the temperature of the air exiting the tube. Air contact with the ground is diminished 2.5 times, while the convective intensity move coefficient ascends by 2.3 times. To put it another way, the higher the wind speed, the smaller the temperature increases are since the latter impact is more dominating. At high speeds, the reduced contact time results in poor performance.

3) Tube Length's Effect: We can conclude that some length is important and no performance improvement is seen beyond a certain length, regardless of length. From this, we can conclude that a length of about 10 m is insufficient for all considered climatic zones, according to Lee KH, Strand RK [6], but the length is If it exceeds 70m, there is no big advantage.

4) Effect of Tube Depth: Outdoor conditions and soil composition, as well as their thermal and water content, influence the temperature of soil. The temperature of the ocean floor varies, but it eventually becomes stable. This is the same year-round temperature. And since this temperature stabilizes after a depth of 1.5 meters, it can be concluded that the depth should be higher. According to (EREC2002), depths greater than 3.5 meters are not allowed [7].

5) Tube Length, Diameter, and Air Flow Rate Impact: The cooling capacity of a system is directly proportional to the overall area, which is the foundation of the design. Changing the pipe's length or diameter has two effects on this. The mass flow rate decreases as the diameter is increased, but the pressure drop and fan output rise as the length is extended. EPEC2002 recommends that parallel pipes of appropriate length and diameter be used. The air reaches the ground temperature quickly, so no large pipes are needed. Generally, 150-450 mm pipes are used. (IEA1999)

III. CONCLUSION

A speed of 2-5m / s is suitable because the wind speed is high and the temperature contrast between the power source and the channel can be reduced. The EUT is stable at a depth of 1.5m, so you need a depth of at least 2m to get the desired effect. The air reaches the ground temperature quickly, so there is no need to increase the diameter of the pipe.

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