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A Review Paper Different Models Of Earth Air Heat Exchanger

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Abstract: In this paper air conditioner with ground coupled condenser is used for air conditioning in residential building is presented. This paper presents a review of air conditioner with ground coupled condenser that can achieve the multi functions with improved energy performance. It improves the efficiency of residential air conditioning units. With the improvement of standard of living, air-conditioning has widely used. In this paper, recent research is reviewed on air-conditioning systems and indoor air quality control for human health. The problems in the existing research are summarized. The ground may be used as a heat source, a heat sink or as a heat storage medium by means of vertical/Horizontal ground heat exchangers. Over the years various analytical and numerical models of varying complexity have been developed and used as design and research tools to predict, among others, the heat transfer mechanism inside a borehole, the conductive heat transfer from a borehole and the thermal interferences between boreholes. This paper is based on reviews of scientific work and provides a state-of-the-art review of analytical and hybridmodels for the vertical/Horizontal ground heat exchangersA further study is suggested on air-conditioning systems and indoor air quality control for healthy indoor air environment. The earth's temperature at a certain depth about 3 to 4m the temperature of ground remains nearly constant throughout the year. This constant temperature is called the undisturbed temperature of earth which remains higher than the outside temperature in winter and lower than the outside temperature in summer. When ambient air is drawn through buried pipes, air is cooled in summer and heated in winter. Heat transfer analysis was performed for a single pass ground coupled tube heat exchanger that utilizes in different orientation and different configurations.

Key words- Ground Coupled Condenser, residential building, temperature difference, energy consumption.

I. INTRODUCTION

The energy consumption of buildings for heating and cooling purpose has increased during this time. In general most people feel comfortable when the temperature is between 20°C and 26°C and relative humidity is within the range of 40 to 60%.These condition are achieved through the use of air conditioning. Air-conditioning systems have used in many parts of the world. With the improvement of standard of living, occupants require more comfortable and healthful indoor environment. The factors influences the indoor environment mainly include temperature, humidity, air movement, ventilation and particle pollutants. Air-conditioning has become very important for human because it made human life comfortable but it is the largest energy consumer. Energy consumption of air-conditioning can be decreased by reducing the temperature of sink reservoir.

Application of GHE Models

The modelling of a GHE is an intricate procedure and so far determination of the long-term steady-state temperature response has been the predominant modelling application. Even this basic task usually involves many simplifying assumptions. In more common real-world situation, however, GHEs exhibit transient responses that will last for long as well as shortterm intervals. Long or short is decided by the frequency content of the load variations in relation to the thermal properties of the GHE.

The temperature response of a GHE depends on the heat transfer inside the borehole and the heat conduction across the boundary of the borehole. Heat transfer inside the borehole is characterized by its thermal mass and its heat transfer resistance. This resistance may be purely conductive, if the borehole is filled with grout or a viscous liquid. It may contain also a convective term if there is groundwater flow (advection) or thermally induced convection in a water-filled hole. The heat flow from the borehole also depends on various other factors such as the location of the considered borehole in the borehole field and its thermal interaction with the adjacent boreholes. Single borehole systems, which are mostly used in residential applications, can be designed by considering only the long-term response of their GHEs. The two most critical design criteria for these systems, the appropriate design length of the GHE and the need for balancing of the ground loads, can both be determined using long-term response of the GHE. Multiple borehole systems, on the other hand, are generally used for energy storage and are more common for commercial applications. In this case the short-term response of these GHE systems has significant impact on the efficiency of the whole GSHP system. Hence, for these systems short-term response of the GHE is equally important as the long-term response.

Model Developments

Over the years various analytical and numerical models of varying complexity have been developed and used as design and research tools. Among other things, they can be used to predict the heat transfer mechanism inside a borehole, the conductive heat transfer from a borehole and the thermal interferences between boreholes. Some of the most noteworthy numerical models include the work of Eskilson and Claesson (1988), Muraya (1994), Zeng et al. (2003) and Al-Khoury et al. (2005; 2006). Numerical models are attractive when the aim is to obtain very accurate solutions or in parametric analysis. However, most numerical models of GHEs have limited flexibility and extended computational time requirements.

Therefore they cannot be directly incorporated into building energy simulation software and hence they have limited practical application. Hybrid models, however, provide a feasible alternative. Such models have been presented e.g. by Eskilson (1987) and Yavuzturk (1991) and they are used to calculate special temperature response functions numerically. These response functions can then be incorporated into the building simulation software as databases and hence can be used without the inherent

Disadvantages of numerical models. Analytical models, despite being less precise than numerical models, are preferred in most practical applications because of their superior computational time efficiencies and better flexibility for parameterized design. The imprecision in the results of the analytical models correspond to the underlying modeling assumptions made when deriving analytical solutions for GHE. It must, however, be kept in mind that uncertainties regarding the quality of input data may be more significant than uncertainties due to model approximations.

Aim of the Review

This article presents a literature review of the most significant analytical and hybrid solutions used for modelling of the GHE. The purpose of the article is to present the noteworthy GHE models which can be readily used by designers and researchers engaged in the modelling of GSHP systems. The solutions discussed are mainly for the simplest case of a single borehole because the solution becomes complex in case of multiple boreholes due to the thermal interactions between the boreholes. The simplifying assumptions and the resulting limitations

of the analytical models when deriving the temperature responses for GHE are also discussed.The GHE modelling approaches can be divided in two main categories. In the first category are the conventional models which are used to calculate the required borehole depth by predicting its long term performance. These models usually consider the heat transfer from a GHE in a steady-state and model it using long time-steps. Short time-step models, on the other hand, focus more on the transient heat transfer in GHEs. The time step for these models is in the hourly or sub-hourly range. Following the general approach, we have categorized the GHE models under the headings of long-term and short-term response.

II. AIR CONDITIONING

Air conditioning is a collective process that performs many functions simultaneously. It conditions air, transports it, and introduce into the conditioned space. It provide heating and cooling from its central plant or roof top units. It also controls and maintain the temperature, humidity, air movement, air cleanliness, sound level, and pressure discrepancy in a space within predetermined limits for the comfort and health of the occupants of the conditioned space or for the purpose of product processing. Air-conditioning systems is the largest energy consumer that is the biggest challenge which arise now a days. This problem can be overcome by the use of ground coupled heat exchanger in air conditioning system. Basic refrigeration cycle can be seen in Fig. 1.

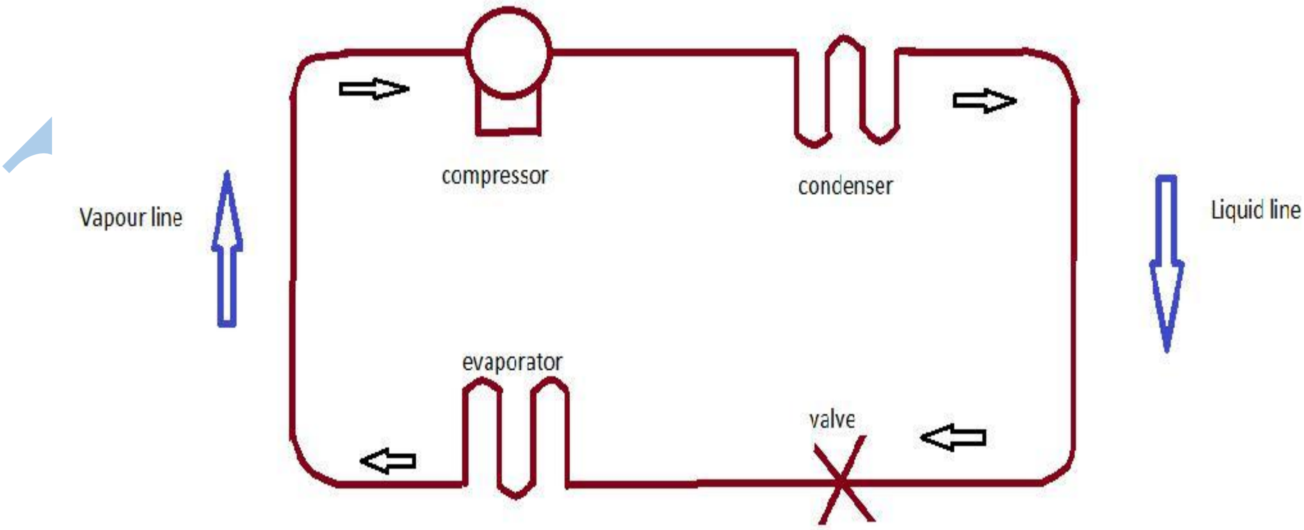

Fig. 1. Basic Refrigeration Cycle.

III. GROUND COUPLED HEAT EX CHANGER

This type of heat exchanger is an underground heat exchanger that can capture heat fro m the ground or dissipate heat to the ground. They use the earth's undisturbed temperature to warm or cool air or other fluids for residential and industrial uses. It usually consists of loops of pipe buried in the ground horizontally or vertically. Vertical l oops go deeper. Horizontal loops are usually buried at one to three meter depth. Temperature regime at this depth and beyond is stable, with no fluctuation and with only a small seasonal or annual variation. T his improves the cop of air-conditioning system as well as save electricity. In ground coupled heat exc

hanger Tubes are placed underground through which refr igerant is drawn.
Horizontal ground heat exchanger can be seen in figure 2. And the arrangement of ve rtical ground heat exchanger can be seen in figure 3. Air conditioner with ground coupled condenser reduces the power consumption and its improves the coefficient of performance. In this paper wide lit erature review based on the literature found from various sources is presented. A review presents the w ork done in this field till now. Author investigated the impact of different ground surface boundary conditions on the efficiency of a single and a multiple parall el earth-to-air heat exchanger system [1] author proposes an even simpler, one-dimensional model with only eight horizontal mesh cells for the ground.

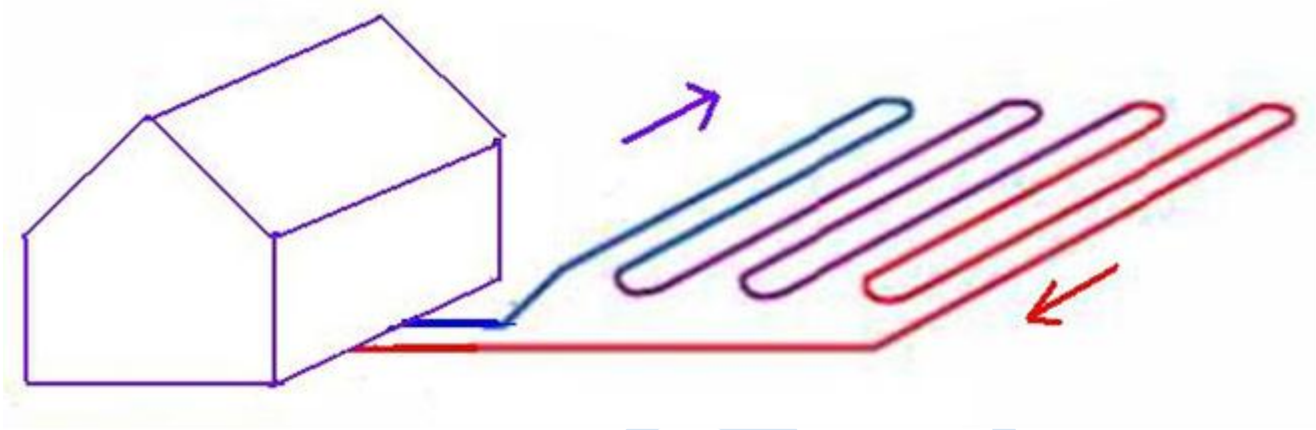

Fig. 2. Ho rizontal Ground Heat Exchanger Configurations.

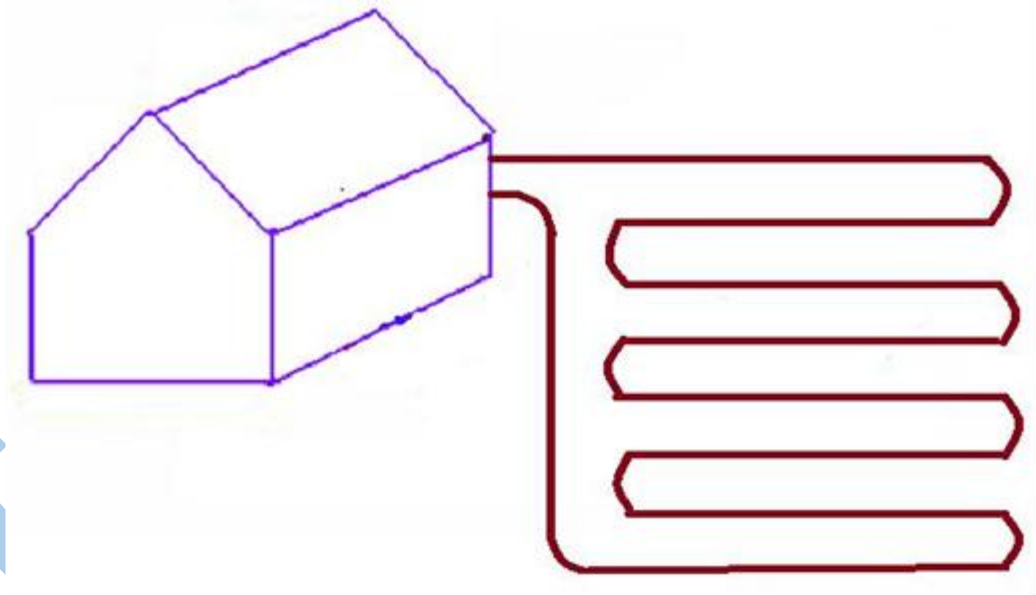

Fig. 3. Vertical Ground Heat Exchanger.

The heat exchanger tubes are placed in one of these cells, in parallel, with regular spacing. Neither a variable temperature profile along th e tubes nor the influences of the nearby building are taken into account. On the other hand this is the only study that considers the coupling of the heat ex changer with the indoor building environment [2]. Author use a simplified way of modeling the air temperature at the outlet of the earth-air heat exchanger . These models, often confined to a linear configurati on with a single tube, take soil temperature as a pa rameter without considering how it may be influenced by the exchange between the air in the heat exchanger and the ground. Author studied the cooling and heat ing potential of recirculation type that operated with en ergy Earth to air heat exchanger saving building lo cated in Indian Institute of Technology Delhi (India) [3]. Author was to compare ground air collector with typ ical Earth to air heat exchangers coupled with the s ame, as in the previous work, greenhouse. Based on experiments and calculation results they concluded that the first system is a more suitable solution for the heating season [4,5]. Author proposes a model of heat transfer in the ground in two dimensions, based on a heatt balance at the surface and a single-pipe heat exchan ger model. This model has the advantage of having a reduced mesh. However, the system of nonlinear eq uations must be solved via a tool for solving partial differential equations [6]. Author developed a th ermal model for heating of greenhouse by using differ ent combinations
After studying the views of all these authors, Inspires of all these attempt we may proceed toward the ground tubing of condenser of air con ditioning system in different orientation. Still in this context there is chance to improve COP of air conditioning. It also reduces power utilization of Air conditioner s. So I have decided to perform experiment in this area . A ground coupled heat exchanger in a horizontal l oop

in an effort to optimize an already efficient desiggn. Analysis will be performed for a single pass ground coupled heat exchanger that utilizes as a closed loop, and that uses horizontal orientation in the syste m. Calculations will be performed to determine the length of pipe required to achieve a specific outlet tem perature as well as pressure drop inside the ground tub ing on varying inlet and exterior temperatures. This is due to the fluid (refrigerant) entering the pipe with a varying inlet temperature and exiting the pipe at the temperature of the refrigerant or soil on the outside of the pipe.

IV. CONCLUSION

After studying the views of auth ors. Inspires of all these attempt we may proceed that The technology of air conditioner with ground coupled condenser reduces energy consumption, fuel cost and global warming and air conditioner turns out to be flexi ble, multi-functional, and the overall Coefficient of perfo rmance of the device can be much improved.

The conventional air-conditioner is a big consumer of power while in air conditioner with ground coupled condenser reduce power consumption. In this system the seasonal thermal storage ability of the soil, which has a temperature delay compared to the outdoor temperature? This temperature difference between the outdoor temperature and the soil temperature enables a cooling effect of the hot summer air. So the utilization of the stored cold in the ground with the means of an underground heat exchanger produces positive effect on the C.O.P. Further future scope in air conditioner with ground coupled condenser is that the feasibility of this system for extreme summer and extreme winter is might be studied. The modified air conditioner seems to be interesting system for rainy climate and awaits more further investigation.The Temperature of soil at different depth can also be obtained during the ground cooling as condenser. The experiment on different types of soil in the pit and compared with this results obtained and which soil give better results.

V. REFERENCES

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