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A Review on Performance of Air Conditioner with Ground Coupled Condenser

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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. A 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.

Keywords: Ground Coupled Condenser, residential building, temperature, 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.

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.

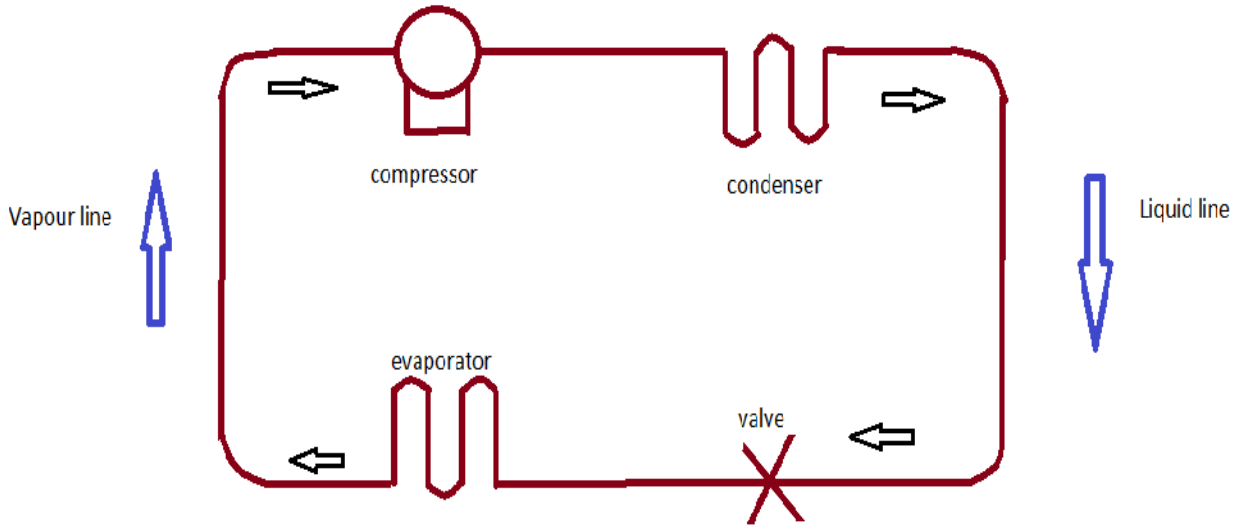

Fig. 1. Basic Refrigeration Cycle.

III. GROUND COUPLED HEAT EXCHANGER

This type of heat exchanger is an underground heat exchanger that can capture heat from 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 loops 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. This improves the cop of air-conditioning system as well as save electricity. In ground coupled heat exchanger Tubes are placed underground through which refrigerant is drawn. Horizontal ground heat exchanger can be seen in figure 2. And the arrangement of vertical 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 literature review based on the literature found from various sources is presented. A review presents the work 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 parallel earth-to-air heat exchanger system [1] author proposes an even simpler, one-dimensional model with only eight horizontal mesh cells for the ground.

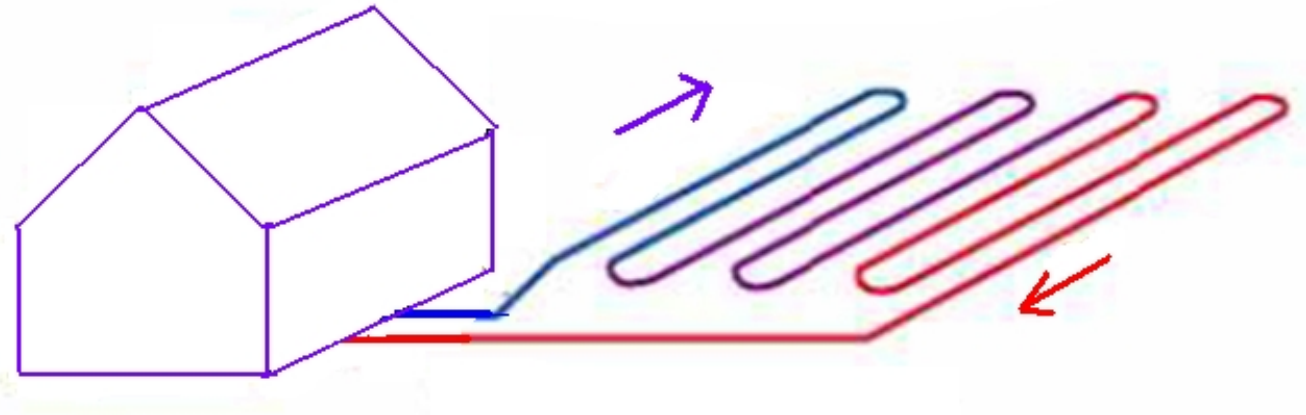

Fig. 2. Horizontal Ground Heat Exchanger Configurations.

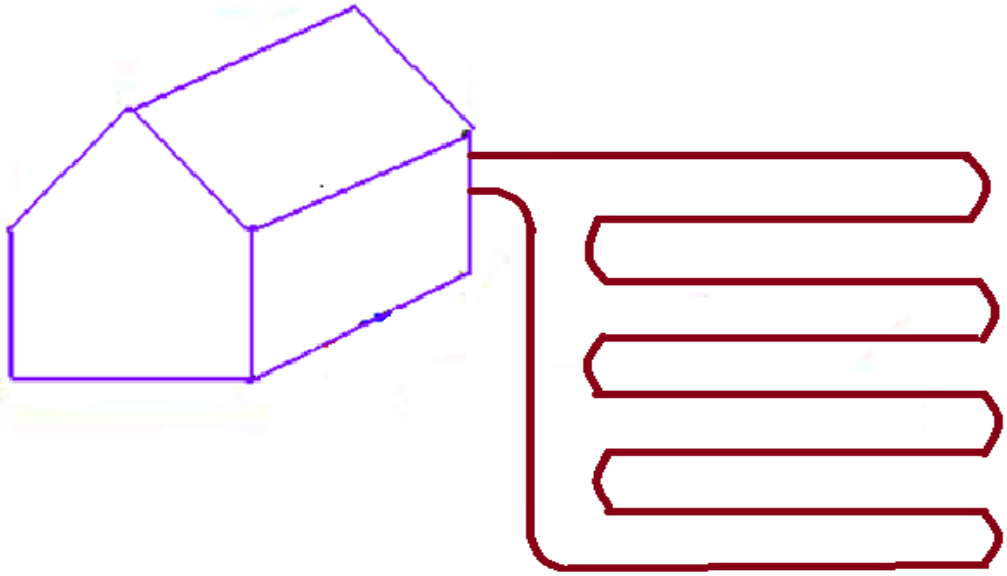

Fig. 3. Vertical Ground Heat Exchanger.

The heat exchanger tubes are placed in one of these cells, in parallel, with regular spacing. Neither a variable temperature profile along the 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 exchanger 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 configuration with a single tube, take soil temperature as a parameter 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 heating potential of recirculation type that operated with energy Earth to air heat exchanger saving building located in Indian Institute of Technology Delhi (India) [3]. Author was to compare ground air collector with typical Earth to air heat exchangers coupled with the same, 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 heat balance at the surface and a single-pipe heat exchanger model. This model has the advantage of having a reduced mesh. However, the system of nonlinear equations must be solved via a tool for solving partial differential equations [6]. Author developed a thermal model for heating of greenhouse by using different combinations of inner thermal curtain, an earth–air heat exchanger, and geothermal heating [7].

After studying the views of all these authors, Inspires of all these attempt we may proceed toward the ground tubing of condenser of air conditioning system in different orientation. Still in this context there is chance to improve COP of air conditioning. It also reduces power utilization of Air conditioners. So I have decided to perform experiment in this area. A ground coupled heat exchanger in a horizontal loop in an effort to optimize an already efficient design. 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 system. Calculations will be performed to determine the length of pipe required to achieve a specific outlet temperature as well as pressure drop inside the ground tubing 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 authors. 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 flexible, multi-functional, and the overall Coefficient of performance 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.

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