Earth Tube Cooling System

Narendra Patel[1] Mukesh Lohar[2] Pratyush Verma[3] Ravindra Panwar[4]
[1,2]Assistant Professor [3]PhD Research Scholar [4]PG Student
[1,2]Department of Mechanical Engineering [3,4]Department of Renewable Energy Engineering
[1,2,4]GITS, Udaipur [3]CTAE,Udaipur

Abstract— Energy deficiency is one of the major problems that our world is facing now a days. So it has become very important to find new and innovative ways of using the renewable energy sources which are easily available on earth and it's a matter of just utilizing that energy properly like Solar energy, Wind energy, Water resources for hydel power plant etc. One of the unconventional source of renewable energy is Geothermal energy. Obviously geothermal energy was used to obtain electricity by the use of turbines but they can also be used to cool a particular room up to a certain extent. This purpose is mainly solved by using the "earth tubes". Earth tubes are long metallic, plastic or concrete pipes that are laid underground and are connected to the air intake of buildings, particularly houses. Their purpose is to provide some pre-conditioning of the air – either pre-heating in the winter or pre-cooling in the summer. The current push towards a wider use of green technologies has generated a resurgence of interest in the concept of earth tubes.

Key words: Earth Tube Cooling System, Closed Geothermal Ground Loops

I. INTRODUCTION

This paper report deals in depth with our project "Closed Loop Ground Source Cooling System". In this paper we have designed and established a closed loop ground source cooling system so as to have a future alternative to traditional heating, and air conditioning systems. Closed Loop Ground Source Cooling System use the relatively constant temperature of the ground to regulate the temperature of a home or building at very high effective efficiency. The system does not create heat through combustion of fuel or passing electricity through resistors; it moves heat from the ground to the home/building for heating and the opposite direction for cooling. In so far as the heat in the ground that these systems use is supplied by the sun, they are using renewable energy.

At the initial stage the project work was divided in to two parts:

1) Digging 5 X 5 X 10 feet deep pit.
2) Preparing the rest of the apparatus as per the drawings

For better description of the project work the project report has been divided in different modules as discussed further.

II. CONCEPT

Ground Source cooling uses the earth or ground water or both as the sources of heat in the winter, and as the "sink" for heat removed from the home in the summer. For this reason, Ground Source cooling systems have come to be known as earth-energy systems (EESs). Heat is removed from the earth through a liquid, such as ground water or an antifreeze solution, upgraded by the heat pump, and transferred to indoor air. During summer months, the process is reversed: heat is extracted from indoor air and transferred to the earth through the ground water or antifreeze solution.

III. TYPES OF GROUND SOURCE HEAT PUMP

A. *Closed Geothermal Ground Loops*

The most typical geothermal installation utilizes a closed loop system. In a closed loop system, a loop of piping is buried underground and filled with water or antifreeze that continuously circulates through the system. There are four major types of closed loop geothermal systems: horizontal loops, vertical loops, slinky coils and pond loops.

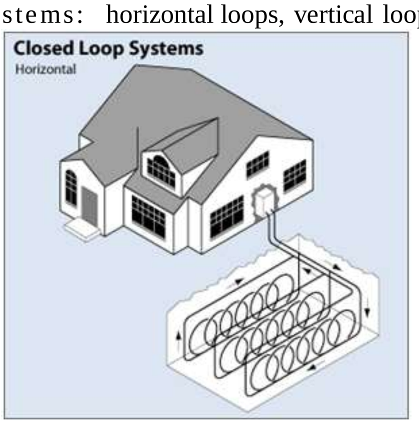

Fig. 1:

B. Horizontal Geothermal Ground Loops

If adequate soil or clay based land is available, horizontal geothermal ground loops are typically one of the more economical choices. In horizontal geothermal ground loops, several hundred feet of five to six feet deep trenches are dug with a backhoe or chain trencher. Piping is then laid in the trench and backfilled. A typical horizontal ground loop will be 400 to 600 feet long for each ton of heating and cooling. Because of the amount of trenching involved, horizontal ground loops are most commonly used for new construction. Finally, because horizontal geothermal ground loops are relatively shallow, they are often not appropriate for areas with extreme climates such as the north or deep south Depth.

C. Vertical Geothermal Ground Loops

When extreme climates, limited space or rocky terrain is a concern, vertical geothermal ground loops are often the only viable option. This makes them popular for use on small lots and in retrofits. In vertical geothermal ground loops, a drilling rig is used to drill 150 to 300 foot deep holes in which hairpin shaped loops of pipe are dropped and then grouted. A typical vertical ground loop requires 300 to 600 feet of piping per ton of heating and cooling. Vertical loops are typically more expensive than horizontal loops, but are considerably less complicated than drilling for water. Less piping is also required for vertical geothermal ground loops as opposed to horizontal loops as the earth temperature is more stable at depth.

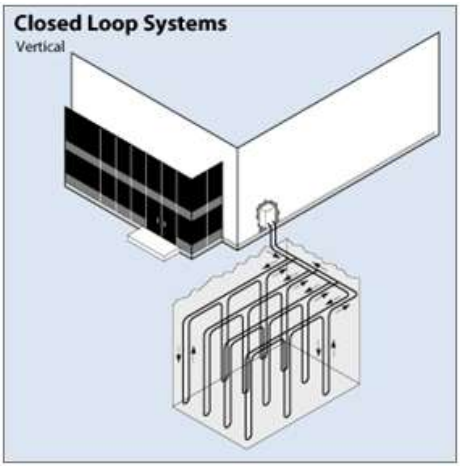

Fig. 2:

D. Slinky Coil Geothermal Ground Loops

Slinky coil geothermal ground loops are gaining popularity, particularly in residential geothermal system installations. Slinky coil ground loops are essentially a more economic and space efficient version of a horizontal ground loop. Rather than using straight pipe, slinky coils, as you might expect, use overlapped loops of piping laid out horizontally along the bottom of a wide trench. Depending on soil, climate and your heat pumps run fraction, slinky coil trenches can be anywhere from one third to two thirds shorter than traditional horizontal loop trenches.

E. Geothermal Pond Loops

If at least a Â½ acre by 8 ft deep pond or lake is available on your property, a closed loop geothermal system can be installed by laying coils of pipe in the bottom of a body of water. However, a horizontal trench will still be needed to bring the loop up to the home and close the loop. Due to the inherent advantages of water to water heat transfer, this type of geothermal system is both highly economical and efficient.

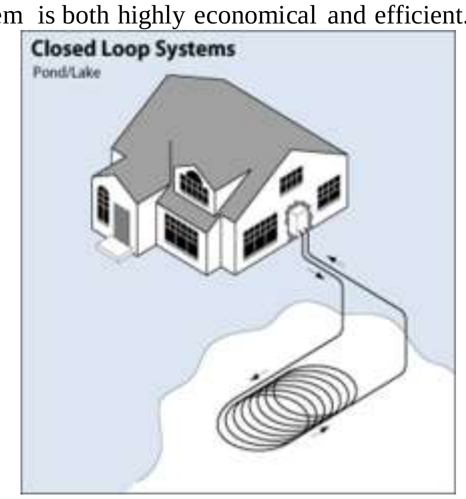

Fig. 3:

F. Open geothermal ground loops

With open geothermal ground loops, rather than continuously running the same supply of water or antifreeze through the system, fresh water from a well or pond is pumped into and back out of the geothermal unit. Both an abundant source of clean water and an adequate runoff area are required for a successful open loop system. While double well designs can be economical, use of open geothermal ground loops is generally discouraged and even prohibited in some jurisdictions. Water quality is key to an open loop design as mineral content and acidity can quickly damage geothermal units. Also, improper installation or runoff management of an open loop geothermal system can result in ground water contamination or depleted aquifers.

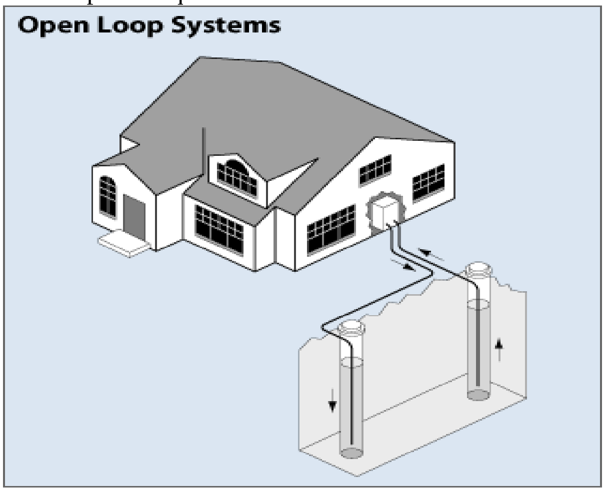

Fig. 4:

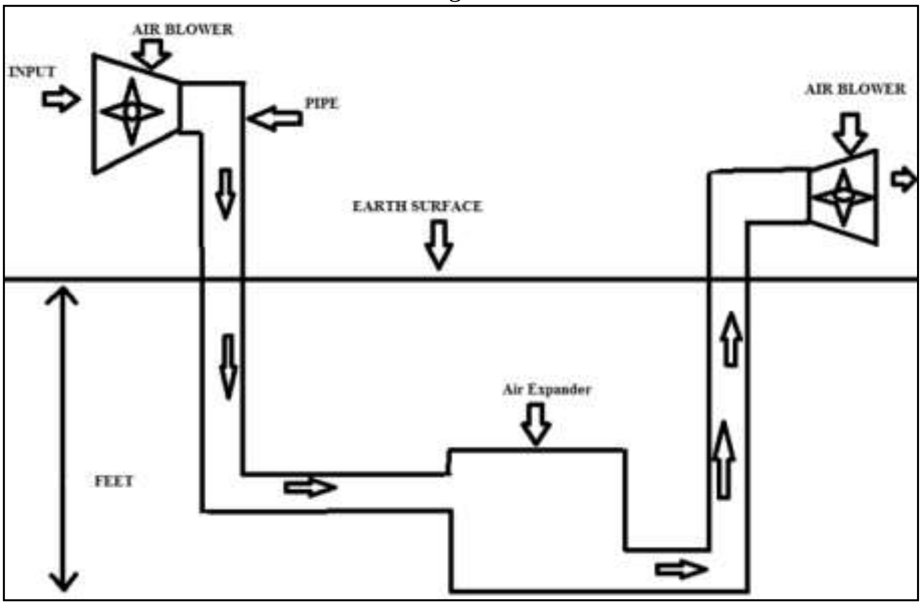

Fig. 5:

IV. WORK PLAN LAYOUT: 4

A. Advantages

- Ground source energy versatile in its use.
- It is cheaper, compared to the energies obtained from other sources both zero and fossil fuels.
- It is least polluting compared to the other conventional energy sources.
- It is classified as renewable because the earth's interior is and will continue in the process of cooling &heating for the indefinite future.

B. Disadvantages

- Drilling operation is noisy.
- The earth may contain H_2S, CO_2,NH_3 and radon gas etc. if these gases are vented into the air, air pollution will be hazard.

C. Applications

- Space heating & cooling for various kinds of buildings.

- Dried milk production.
- Fruit and juice canning and bottling.
- Crop drying.
- Space heating(building and greenhouses)
- Fish farming.

REFERENCES

[1] AGUSTIN ADARVE et al (2012), Conductive Cooling Using Underground Buried Pipes Low energy cooling systems for providing comfort to workers in an industrial building, PLEA2012 - 28th Conference, Opportunities, Limits & Needs Towards an environmentally responsible architecture Lima, Perú.
[2] Kwang Ho Lee and Richard K. Strand, implementation of an earth tube system into energyplus program. science direct elsevier
[3] Gaffar G.Momin (2013), Experimental Investigation Of Geothermal Air Conditioning. American Journal of Engineering Research (AJER).
[4] Ajoy Debbarma (2013), Performance of proposed earth-Tank Heat Exchanger: A Computational Study, IOSR Journal of Engineering (IOSRJEN), Vol. 3, Issue 1 (Jan. 2013), ||V2|| PP 68-72.
[5] Joerg Henkel et al. (2004), analysis, design and testing of an earth contact cooling tube for fresh air conditioning, Proceedings of Solar 2004: A Solar Harvest: Growing Opportunities July 11-14, 2004, Portland, Oregon
[6] Ashish Kumar Chaturvedi and V N Bartaria, performance of earth tube heat exchanger cooling of air—a review.
[7] M. Jamil Ahmad et al. (2010), Heating/cooling potential and carbon credit earned for
[8] dome shaped house, international journal of energy and environment.
[9] Afeef Choorapulakkal, Masa Noguchi, A Proposed 'Water Tube Heat Exchanger' Space Cooling System Performance Analysis, Civil Engineering and Architecture 2(4): 166-169, 2014.
[10] Mr. Sanjay N. Mali et al.(2014) "Application of Geothermal Cooling Techniques to Improve Thermal Conditions of a Residential Building", International Journal of Civil and Structural Engineering Research.
[11] Girja Sharan, Performance of Single Pass earth-Tube Heat Exchanger: An Experimental Study.
[12] S.F. Ahmed et al. Numerical Modelling of Hybrid Vertical Earth Pipe Cooling System, 19 th Australasian Fluid Mechanics Conference Melbourne, Australia 8-11 December 2014.
[13] John Tin Yuan En et al. A Review of Technological Developments in Cooling System for Different Climates, Middle-East Journal of Scientific Research