A MINIATURE WORKING MODEL OF GEOTHERMAL AIR CONDITIONING SYSTEM IN A BUILDING

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Abstract—The use of geothermal technology for cooling and heating of building is growing in importance due to rising energy cost and mounting political will to replace conventional heating and cooling system with practical alternatives that are both ecologically and economically sound. There are numerous potential applications of geothermal energy in building sector. In this project a miniature working model of geothermal air conditioning system in residential building has to be implemented. Ground energy systems use the ground and groundwater beneath a site as a heat source or sink to reduce energy costs and improve the environmental performance of buildings. This paper reviews to build a cost effective optimum miniature model inside a building and to develop cost effective means of air conditioning. The temperature of soil for the application of geothermal air conditioning is around 55°F.

Keywords -Air conditioning, Geothermal Energy, Geothermal technology, Ground energy system

I. Introduction

Geothermal energy is the second most abundant source of heat on earth, after solar energy. Geothermal energy can be defined as the energy derived from the heat within the earth. This heat is created through the constant movement of magma and tectonic plates on the surface of earth. When considering geothermal energy, it is thought that regions of volcanic activity are most suitable for optimal usage. Large geothermal power plants produce massive amount of electricity by pumping water into fissures in the hot bedrock below to create steam. This steam then turns large turbines which can produce electricity. Only certain regions in the world are capable of producing such massive amounts of energy. These regions are found at the boundaries between tectonic plates and therefore limit the usage of this technology.

Geothermal temperature increases with depth in the earth's crust. 100 million barrels of oil per day, the thermal energy to a depth of 10km would supply all of mankind's energy needs for six million years. However, based on current technology, only a fraction of this energy is available as a recoverable source.

Geothermal is named comes from two Greek letter "Geo" have means 'earth' and "thermal" that means 'heat'. Renewable energies (sunlight, wind, tidal, wave, geothermal etc.) are utilize by engineering technologies and convert into more usable from a combination of two sources: the original heat produced from the formation of the earth by gravitational collapse and the heat produced by radioactive decay of various isotopes. Because of thermal conductivity of rocks is so low, it taking many billions of years for the earth to cool.

II. Geothermal air conditioning system

Geothermal systems work differently than ordinary heating and cooling systems. Conventional systems have to produce heat by burning some type of fuel.

*A.*Geothermal pit

In geothermal pit, installed copper tube loop which is carrying air. A depth of pit is varies according to geographical location.The pit is usually dug till we get the moist soil.

Fig.1. Geothermal pit

B. Blower

Blower use for force the air from room to the loop. It pressurizes the air and circulate throughout the circuit. Geothermal technology harnesses the energy stored beneath the Earth's surface, using it to heat and cool your residence or building with the help of a blower.

Fig.2. Blower

C. Earth tube heat exchanger

The copper loop is buried in the ground and it is working like a heat exchanger same as cooling coil and evaporative coil working in chiller.

Fig.3. Copper tube

D. Solar panel

It is used for providing supply for the working of blower.Solar panels absorb sunlight as a source of energy to generate electricity or heat. Solar panel taken is of 12watt powered one.

Fig.4. Solar panel

E. Braced copper tubes

The durable copper construction provides long-lasting reliability. Perfect for securing copper pipe in residential and commercial environments such as potable water, air conditioning and refrigeration. These copper straps offer low-maintenance, dezincification resistance and reusability making it ideal for sustainable projects.

Fig.5. Braced copper tubes

III. Working

During winter season the cold air is taken from the room using a blower and transmitted through the copper tube. When the air reaches below ground heat is conducted from ground to the air in the copper tube. Hot air is always available in the room by this process.

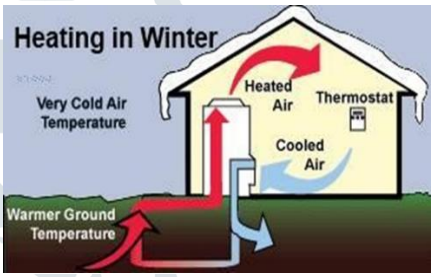

Fig.6. Heating mechanism

During summer season the hot air is taken from the room using a blower and transmitted through the copper tube. When the air reaches below ground heat is conducted from air in the copper tube to the ground. Cold air is always available in the room by this process.

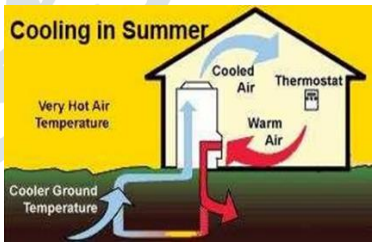

Fig.7. Cooling mechanism

IV. Efficiency

Heating and cooling systems carry an efficiency rating which is certified by the Air-Conditioning, Heating, and Refrigeration Institute. The higher the Energy Effifiency Ratio, the more efficient the unit.For cooling efficiency, the same energy efficiency rating is used as for air conditioning systems, the Energy Efficiency Ratio.Most geothermal systems have COPs of 4.

V. Advantages

- ✓ Sustainable and renewable energy resources.
- ✓ No pollution.
- ✓ Gives fuel cost savings.
- ✓ More efficient :lower electric bills.
- ✓ Less maintanence required.
- ✓ Quiet operation.

VI. Disadvantages

- ✓ Installation cost is high.
- ✓ Disturbance of soil near building.
- ✓ Not suitable for all type of soil.
- ✓ At least 1 hour to reach comfort zone.

VII. Drawing in AutoCAD

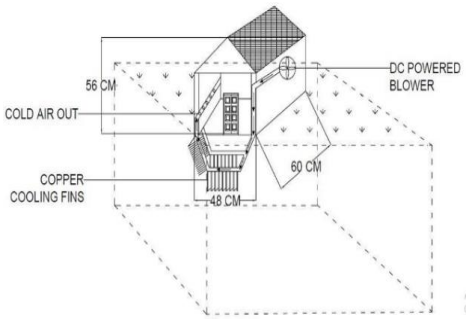

Figure.8. Drawingin AutoCAD

VIII. Progressing stages

*A.*Cutting

For metals many methods are used and can be grouped by the physical phenomenon used. Chip forming - sawing, drilling, milling, turning etc. Shearing - punching, stamping, scissoring. Abrading - grinding, lapping, polishing; water-jet. Heat - flame cutting, plasma cutting, laser cutting

Fig.9. Cutting of MS flat bar

B. Welding the frame work

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal**.**

Fig.10. Welding

C. Grinding

Grinding practice is a large and diverse area of manufacturing and tool making. It can produce very fine finishes and very accurate dimensions yet in mass production contexts it can also rough out large volumes of metal quite rapidly.

Fig.11. Grinding

D. Finishing stages of frame work

In this stage we covered entire frame work with MS sheet for the finishing of the frame.

Fig.12. Finishing stages of frame work

E. Assembling of braced copper tubes

In this stage the braced copper tubes were inserted in the frame work. The copper tubes are provided at the bottom of the frame. One end of copper tube is connected to the air blower and other end is connected to the bottom side of wall for the purpose of cooling effect.

Fig.13. Assembling of Braced Copper Tubes

F. Finished working model

In this stage we finally assembled all the component parts of the model and we measured the difference in temperature as shown in Table 7.1 at two levels by using digital meter indicating temperature

Fig.14. Completed working model

IX. Observed readings

Table.1. Obseved readings

Sl. No.	Temp. at Inlet (˚C)	Temp. at Outlet (˚C)	Time Taken for attaining Temp. Difference (min)
1	32.2	29.2	3
2	31.8	28.6	3
3	31.5	25.9	3

After completing the working model a number of tests were conducted and the following results as shown in Table.1. were obtained. From this it is clear that a temperature at the outlet is less than temperature at the inlet.

X. Conclusion

Geothermal air conditioning system are highly efficient heating technologies that allow for reductions in Carbon dioxide emissions, the potential avoidance of fossil fuel usage and economic advantages. This system utilize significantly less energy to heat a building than alternative heating systems. Many variations of geothermal systems for heating exist, with different configurations suitable in different situations and most locations around the world. Heat exchanger or energy piles have the potential to reduce energy demand in built structures and tackle the ever challenging climate debate. Energy piles are increasingly used in various parts of the world today, and the benefits, experiences and opportunities gained from these experiences can be adapted and applied to the localcondition.

Developments in this technology have resulted in systems that are cost efficient, environmentally beneficial and socially acceptable. Furthermore, geothermal energy pile systems have been found to have great potential as an aid in tackling climate challenges and meeting legislation requirements. Research has found that over 80 countries have utilized shallow geothermal energy technology and gained the benefits and opportunities from it..

After completion of our project we felt that using geothermal air conditioning system in a building is more cost effective compared with normal air conditioning system. Even though the initial cost of this system is very high. Only one disadvantage of this system is that it may take one hour to reach the comfort zone. While doing our project we faced difficulties during welding, bracing etc. But the difficulties were overcame after the completion of the working model, since we had successfully completed our project.

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