

HVAC System - Geothermal Heat Pumps

What is HVAC system?

HVAC system stands for “heating, ventilation and air conditioning” all in one system. It is used to build a mechanical system that delivers thermal comfort and improves indoor air quality for the occupants of the residential or commercial building. Based on the location, zones and distribution, this system can be categorized into two arrangements i.e., primary and central system. Primary system includes heating, ventilation and air conditioning tools, while central system is located outside the area in a central control room and delivers conditioning through ductwork system. The ‘V’ in HVAC system is for ventilation which is the process of providing better quality and fresh air indoors and removing odors, smoke, airborne bacteria, moisture and carbon dioxide. It also controls the indoor temperature and oxygen replacement.

Geothermal HVAC

It is also named as “Ground source heating and cooling” or “Geo-exchange” system. Geothermal based HVAC system uses temperature of Earth for heat exchange purposes. Irrespective of the climate above the ground, the temperature below Earth remains same. “Geothermal based heat pumps” are considered to be highly efficient for the last decade. This system depends on exchange of heat between ground and air that provides heating and cooling to residential and commercial occupants/ buildings.

There are two forms of the geothermal based heat pumps:

- **Direct geothermal:** are mostly used in areas of tectonic or volcanic activities resulting in heat of underground water naturally. Here, conditioning of air in the building is done by the help of heat exchangers or by pumping hot water to be used in its current state.
- **Deep and improved geothermal:** are used for generating electricity for many purposes such as agriculture, industrial and commercial applications. This system depends on the steam under the Earth which is then accessed with the help of drilling machines, 10 to 400 feet or more below the earth crust.

Working of Geothermal based HVAC System

Geothermal based HVAC system uses the science of refrigeration to work on for cooling and heating purposes of the buildings. Considering the second law of thermodynamics, heat always travels from warm or hot zones to the area of cold temperature. In a geothermal based HVAC system, the electrically driven heat pump rounds fluid, normally water or refrigerant, with the help of long and extensive loops of underground pipelines. Henceforth, using this process, from the ambient air present in the building, heat is then transferred to the ground and vice versa.



Fig. 1. Geothermal System

Winter operation

In winter period, the heat pump propels the fluid using ductwork pipelines where the temperature of the fluid increases by warmer rocks, underground water or soil. This hot fluid is pumped back to the building. After this, air is then warmed using heat exchanger that transfers heat extracted from fluid to the “building’s heating system”. Water temperature can be increased for usage purposes in the building by installing desuperheater. This process of cooling and heating is keep on repeating, where the cool water/ fluid is pumped to the ground, is warmed there and return back to the building for heating purposes.

Summer operation

During summer time, the indoor heat pumps take away the warm air from the building and eliminates the heat leaving behind the cool air that is then spread by the help of ventilators or air conditioners. The heat eradicated from the air is again pumped into the earth using ground pipelines. In this way, as the fluid absorbs the heat from the air, injects into the earth, therefore, building is cooled down.

Advantages of Geothermal Heat Pumps

The advantages of underground heat pumps systems are as follows:

- They have low maintaining cost.
- They save up to 40% to 70% of energy every year ultimately resulting in saving bills.
- They are the most robust and efficient systems that can last for about 30 years once installed.
- They are environment friendly systems with no combustion at all. Moreover, they cut down the release of “conservatory gases”.
- They can be planted near homes as they do not produce any noise.
- As this is an underground system therefore, every pipeline is hidden and suppressed under the ground, therefore, do not become the source of “aesthetic degradation” of outdoor of buildings and homes.
- They use DE superheating system for cooling or heating of water.
- These geothermal heat pumps can be used for heating the floor or covering the floor.
- Ductwork pipelines are implemented using heat pumps to preserve humidity and sustain comfortable and normal temperature all over the year depending on the change of climate.

Comparison Between Geothermal Systems and Gas Boilers

Geothermal heat pumps are better than conventional gas boilers as

- Old boilers are only 50 – 70 % efficient resulting in waste of high amount of energy whereas, geothermal heat pumps are energy efficient and no loss of energy occur using this system because they work by absorbing heat from outside and moving this indoors.
- Life span of gas boilers is just 8 – 10 years while that of geothermal heat pumps is more than 25 years.

References

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