Technology Today

Alan J. Pierce

Ceothermal Heating and Cooling

FOR generations, the root cellar was the refrigerator. Our ancestors took advantage of the fact that 6' below the ground, our planet provides a constant temperature of 55°. Can this constant temperature provide a year-round cost-efficient heating and cooling system for our homes, businesses, and factories of tomorrow? In fact, technology that takes advantage of this is already in use.

A new house in Currituck, NC, has been designed to take full advantage of geothermal heating and cooling. Its designer and owner, Woody Gardner, spent years researching this technology before designing his new home. He then worked with his subcontractors during all phases of construction to change his dream into reality. On my visit to his new home, Gardner summarized his construction achievement, emphasizing that his home's systems aren't unique, "One of the most exciting things about this house is the fact that is has been completely built with off-the-shelf technology."

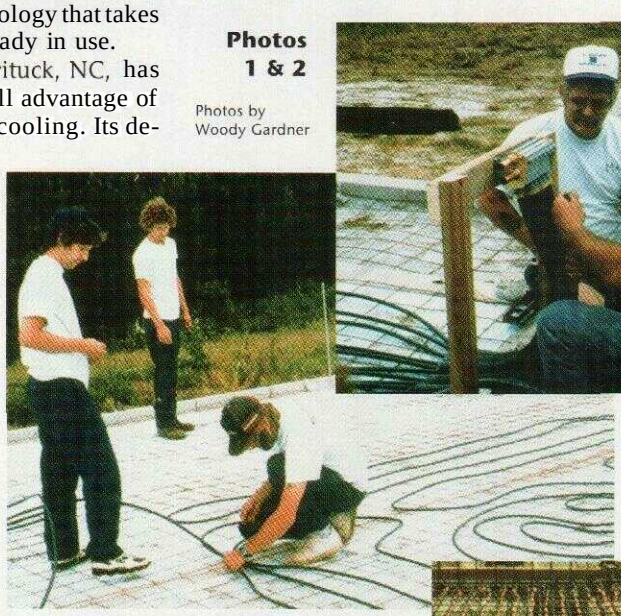
The geothermal heating and air-conditioning system that is central to his home is now available for installation in new residential and commercial construction. The systems are also designed to replace older heating and cooling technology in existing structures. These systems provide closed and open loop heat transfer by channeling hot or cold temperatures from a home's interior into the ground,

In Gardner's home, the geothermal closed loop part of the system pumps anti-freeze through fifteen hundred feet of plastic tubing buried at least 6' into the earth. This part of the system is comparable to the radiator of a car. Instead of having a very compact radiator core, however, the heat transfer takes place in 1,500' of tubing that is buried in double loops in deep trenches outside the area covered by the foundation.

The outside loop system transfers heat to a special heal pump located in the home. Heat from the closed loop system transfers to an open loop system that sends heated water to a network of plastic pipe cast into the home's concrete floor. Photos 1 and 2 show construction of the network of pipes and their manifold that will eventually control the water flow. This same water also fills the house's conventional hot water heater.

Photos 1 & 2

Photos by Woody Gardner



In winter, the flooring of the house radiates 85° to heat the home. The open loop characteristic of this part of the system also keeps the hot water heater always ready to supply water for conventional cooking, washing, and bathing. In summer, the heat transfer process that cools the home creates an endless supply of hot water.

For summer cooling, the closed loop system transfers its cool temperatures to a forced air system in the house. The floor tubing system is not used for cooling because the water moisture in the air would cause condensation on the floor. During the design phase, Gardner included other systems to assist in the heating/cooling process, including a full wall of special, large thermal windows to allow solar heating, careful use of insulation to prevent heat loss, seven zones to control heating in different flooring parts of the house, and a heat pump to push the temperature up just a few degrees into the comfort zone.

The magic of the system is that once installed, all that is needed to raise or lower the temperature in a dwelling to within 15° of what most people considerable comfortable is an electric heat pump. We can realize significant energy savings, even if we obtain the last few degrees of heat by electric, oil, or gas systems.

The cost-effectiveness of geothermal heating makes it a viable system for street use to remove snow and ice from highways, airport runways, and even home driveways. An overpass in Amarillo, TX, shown under construction in photo 3, is the first US highway bridge with a geothermal heated road bed, If this experimental project of the Federal Highway Administration is successful, geothermal heating could become a standard design feature for northern highways.

IGSHPA Photo

Photo 3

Woody Gardner, Maxxon Southeast, and Helen Robertson at the International Ground Source Heat Pump Association (ISGHPA) provided assistance in writing this article.

Recalling the Facts

1. Describe how a geothermal heat transfer system works.
2. How far do you have to dig into the earth to reach a constant temperature of 55 ?
3. Why is an antifreeze solution used in most geothermal heating systems? TD

Alan J. Pierce is associate professor, Department of Technology, Elizabeth City State University, Elizabeth City, NC 27909.