THE ENERGY OBSERVER

Energy Efficiency Information for the Facility Manager

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Ground Source Heat Pumps

The Energy Observer summarizes published material on proven energy technologies and practices, and encourages users to exchange experiences with generic energy products and services. This quarterly bulletin also identifies informational sources and energy training for facility managers and staff. ***The Energy Observer*** is a service of the **Energy Office, Michigan Department of Labor & Economic Growth.**

There are many options for heating and cooling systems available on the market. However, many of them rely on fossil fuels to condition building space. This edition of the Energy Observer focuses on a heating and cooling method often referred to as a Ground Source Heat Pump System. This type of system uses the constant temperatures of the earth to condition building spaces. Electricity is still required to operate the pumps for this system, but the thermal conditioning is supplied by a renewable resource.

What Are Ground Source Heat Pumps?

Ground Source Heat Pumps (GSHPs) tap the stored energy of the greatest solar collector in existence: the earth. These systems use the earth's relatively constant temperature to provide heating, cooling, and domestic hot water for homes and commercial buildings.

GSHP Systems use a refrigeration cycle to extract and transfer heat. These systems use the earth as a source of heat in the winter and as a tool for heat removal in the summer.

The heat pumps are relatively small and easily concealed. Ceilings, closets, basements or attic areas are ideal for these units.

How Do They Work?

Ground source heat pumps can be categorized as having closed or open loops. These loops can be installed horizontally, vertically, or in a pond/lake adjacent to the building.

Closed loop systems operate by circulating water or antifreeze solution through plastic pipes buried beneath the earth's surface. During the winter, the fluid collects heat from the earth and carries it through the system and into the building. During the summer, the system reverses itself to cool the building by pulling heat from the building, carrying it through the system and placing it in the ground. This process creates free hot water in the summer and delivers substantial hot water savings in the winter.

Open loop systems operate on the same principle as closed loop systems. They can be installed where an adequate supply of suitable water is available, and where open discharge is feasible. Benefits similar to the closed loop system are obtained. Examples of open loop water sources are wells, lakes, and streams. Open loop systems are not permitted in some environmentally sensitive areas.

Regardless of the type of loop system, the indoor portion of a GSHP system is made up of a series of units called heat pumps. They are distributed throughout a building to supply or remove heat from a space and then returns to the loop system to pick up or release the heat back into the ground.

Design Factors

The type of system chosen and applicability of this technology depends on the available land, soil type, availability of groundwater, energy requirements and the experience of the designer and contractors. These factors will help determine the most economical choice for installation of a ground loop. Work with an experienced GSHP designer to determine the applicability of this technology in your facilities.

Operation And Maintenance Concerns

Regular air filter changes may be time-consuming due to the location and distance between the units.

Proper system design and installation ensure that soil-freezing conditions do not create any system problems. At a soil temperature of 30°F, latent heat moisture in the soil adds

considerably to the capacity of the system, allowing for good performance in northern climates.

Any type of aging, poorly installed, or improperly operated systems have a greater risk for system failure.

COMMISSIONING

There are a number of things that a building owner or GSHP contractor should do to ensure proper operation of these systems. Following are a few key items that should be addressed.

Flushing the loop after installation to ensure the system is in good working order. This includes flushing of debris, air purging, pressure testing, and final charging of the system with antifreeze. Inspect, test and start up all pumps to verify proper operation.

Performance testing and seasonal testing of controls should be performed to ensure proper operation of the system. Staff should also be instructed on proper use of these controls.

BENEFITS

- Energy use and fossil fuel consumption can be reduced by 40-70% compared to conventional systems. Water consumption may also be reduced since cooling towers and water-cooled condensers are not required.
- GSHPs reduce peak energy demand and reduce the heat island effect, since waste heat is returned to the ground, not the outside air.
- The seasonal energy efficiency ratio (SEER) compares rejected heat to energy consumed to rate cooling efficiency. Values greater than eight are preferred. According to the Pennsylvania Ground Source Heat Pump Manual, advanced systems are reaching SEER values of greater than 17.
- Waste heat from the system can be used to heat domestic water when the system is cooling the building.
- Systems can be designed to use multiple heat pumps with dual-speed controls to improve part-load performance. Occupants can control the temperature in each room.
- Controls can assist facilities staff with shutting off unused zones during peak demand periods while allowing critical zones to operate normally without any decreased performance.
- Since piping and pumps are buried or enclosed in the building, damage caused by inclement weather, insects, and vandalism can be greatly reduced.
- GSHP systems require little maintenance aside from regular cleanings of heat exchanger coils and strainers that filter the ground water as well as regular air filter changes. These systems generally have an expected 25- to 30-year life cycle.

FOR MORE INFORMATION…

Rebuild America publication: *Designing High Performance Schools* for additional information and resources for GSHP system design www.rebuild.org

International Ground Source Heat Pump Association
www.igshpa.okstate.edu/

ASHRAE 2003 HVAC Applications Handbook. www.ashrae.org

Visit the Energy Office website for information on current programs, services, past issues of ***The Energy Observer*** and grant information.
www.michigan.gov/energyoffice

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