MIDWEST BUILDINGS
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University of Illinois at Chicago
Grant Hall

GEOTHERMAL HEAT PUMP

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PROJECT PROFILE

MARKET SECTOR
Higher Education

LOCATION:
University of Illinois at Chicago (UIC)
Chicago, Illinois

BUILDING SIZE:
15,000 ft^2

ENERGY APPLICATION:
Space heating and cooling

INSTALLED COST:
$ 5,140,000

- Asbestos Abatement - $77,350
- General Work - $1,656,948
- Curtain Wall - $979,244
- Plumbing - $162,936
- Heating/Piping - $687,067
- Ventilation - $508,227
- Electrical - $511,086
- Owner's Costs - $49,043
- Professional Services - $508,099

GREEN ENERGY:
- Achieves 17-18% annual energy savings
- Energy savings better than predicted

ESTIMATED PAYBACK PERIOD:
20 years

PROGRAM PARTNERS:
- University of Illinois at Chicago
- The Port Family
- Illinois Clean Energy Community Foundation
- Primer Mechanical


Photo courtesy of Energy Resources Center

Grant Hall at University of Illinois at Chicago

PROJECT OVERVIEW

The University of Illinois at Chicago (UIC) is a public higher education facility with over 25,000 students and 15 different colleges. The campus comprises over 100 buildings across 240 acres. The majority of UIC's campus was constructed in the 1960's and recently the university initiated a program to renovate the older buildings to bring the campus into the 21st century. This program included a number of projects that promote energy efficiency and energy conservation. The first building to receive an energy facelift, Grant Hall, a 15,000 square foot classroom building, not only received new windows and lighting upgrades, but a highly efficient geothermal energy system, a geothermal heat pump (GHP). The geothermal heat pump is the first of its kind to be installed on the UIC campus.

WHAT IS A GHP?

A geothermal heat pump (also known as a ground-source heat pump) is a renewable energy solution used primarily for space heating and space cooling, but can also be used to heat water. The concept behind GHP is to use the relatively constant temperature of the earth. The ground temperature below the surface is warmer than the air in the winter and cooler than the air in the summer. Taking advantage of this concept, heat is transferred into the building in the winter and out of the building in the summer.

The three basic components required for a GHP system are:
- An earth connection
- A heat pump
- A thermal distribution system

The **earth connection** is a series of pipes buried in the ground near the building to be serviced. The pipes carry water (or a mixture of water and anti-freeze or other liquid based solution) which is the medium for heat between the ground and the building.

The **heat pump** removes the heat from the fluid, concentrates it and transfers it to the building. For cooling, the process is reversed.

The **thermal distribution system** typically consists of conventional ductwork to distribute the heated or cooled air from the pump throughout the building.

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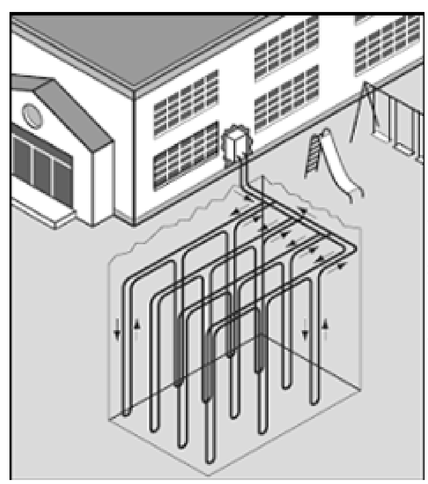
Photo courtesy of UIC Office of Sustainability

Typical Vertical Well Configuration

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UIC ERC Energy Resources Center · Energy Center of Wisconsin · MEEA Midwest Energy Efficiency Alliance · NASEO National Association of State Energy Officials — Energy's Washington Voice · Department of Energy, United States of America

BRINGING IN GEOTHERMAL ENERGY

The geothermal heat pump was evaluated against other potential energy systems to meet Grant Hall's space heating and cooling requirements. The potential technologies investigated included chilled water variable air volume (VAV) systems, rooftop units, condenser/boiler systems and fan and coil units. Assessing a projected 20 year period and accounting for the projected maintenance costs, GHP system was considered the most energy efficient and cost effective option for this application.

BENEFITS OF GHP Compared to Standard HVAC Technologies
Year round heating and/or cooling
Less energy consumed
Lower energy bills
Lower greenhouse gas emissions
Minimal indoor equipment needed
Lower maintenance costs

FOR MORE INFORMATION

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To fund the $5.14M geothermal project, UIC applied for and received a $153,813 grant from the Illinois Clean Energy Community Foundation. The Foundation awards grants to nonprofit organizations, schools, municipalities and other government agencies for programs that will improve energy efficiency or develop renewable energy resources to improve environmental quality in the state of Illinois. Sidney L. Port, a long time benefactor of UIC, donated $2M to the project and the new language and culture center in Grant Hall was named in memory of his daughter, the late Sandi Port. The remaining $2,986,187 was met with university funds.

GRANT HALL'S GHP PERFOMANCE

The GHP system was installed by Primer Mechanical. Grant Hall's geothermal field consists of 14 wells drilled in a vertical configuration in the ground, 500 feet down. The wells are 2.5 inches in diameter and are spaced 20 feet apart. The field takes up a small amount of land and the wells are undetectable to a person passing by above. As shown in the photo to the right, the wells are buried beneath a campus walkway. When Grant Hall reopened on September 19, 2007 with the new Sandi Port Errant Language and Culture Learning Center, the GHP system was introduced. Previously, Grant Hall used hot water and chilled water from UIC campus' central heating and cooling plant to deliver the building's thermal needs. Since the GHPs introduction, Grant Hall has enjoyed a 17-18% energy savings from the previous system. According to former Director of Project Management Services, Boyd Black, the building temperature has remained comfortable for students and faculty alike and there have been no complaints since Grant Hall began operating their GHP system.[1] Mr. Black also stated, following 10 months of successful operation, that no additional HVAC equipment had been required, such as heat exchangers, to maintain the buildings' desired operating temperature. Due to the success of Grant Hall's geothermal system, the adjacent buildings, Stevenson, Lincoln and Douglas Halls, have begun development and construction of their own GHP systems.

BENEFITS OF GHP SYSTEMS

The main benefit of GHP systems is that they consume less energy than standard HVAC systems. According to the U.S. Environmental Protection Agency (EPA), GHPs can consume 44% less energy than air source heat pumps, and up to 72% less

Photo courtesy of Energy Resources Center

Location of Grant Hall's Geothermal Field

than electric resistance heating with standard air-conditioning equipment. GHPs improve humidity control by maintaining a 50% relative indoor humidity making them very effective in humid regions. GHPs are relatively simple systems with few moving parts and are considered very durable and highly reliable. Therefore, GHPs typically require less maintenance over their lifetime when compared to other standard HVAC technologies. The GHP piping often has equipment warranties between 25 and 50 years and the heat pumps usually last at least 20 years.

When configured correctly, GHP systems allow for heating or cooling different building zones to different temperature levels. In addition, GHPs do not require separate heating and air-conditioning systems such as conventional HVAC systems. GHPs allow for year-round heating/cooling due to the difference in air and ground temperatures. Therefore, a building can be made comfortable if the building experiences unseasonably warmer or cooler temperatures. This is beneficial for buildings that provide only heating in the winter and only cooling during the summer, which is typical of many college campuses.

Geothermal heat pumps can be installed in new buildings or in retrofit situations, such as Grant Hall. Because the indoor GHP components need minimal space, the equipment rooms can be much smaller than for conventional HVAC systems. Also, because there are no outdoor components (besides the wells) there is no outside noise attributed to the GHP system.

[1] *Third Annual UIC Sustainable University Symposium. (Oct. 15, 2008) <http://www.standingupforillinois.org/uploads/Black2008SUS.pdf>*