

# SHNNY Seminar – Session 6: Green Building Technologies

Presented 4-5-11 on the Geothermal System at Cedars/Fox Hall, 745 Fox Street, Bronx

---

## **Lantern Group (senior project manager Carol Jackson)/UAI (architect Tony Shitemy)**

- Brief explanation of system (with afterword about other green features)
- Why geothermal/ground source
- Financing
- Construction process
- Lessons learned

## **How the ground source system works**

Geothermal heating and air conditioning uses the ground as a heat source and heat sink, respectively, for heat exchange. The system at Cedars circulates water from the bottom of the well to the top, facilitating heat exchange with the ground, and is a 'standing column well' system. There are four wells ranging from 850' to 1600' deep, with electrically powered well pumps, a plate and frame heat exchanger, circulating pumps (for the building loop), and individual heat pumps located in each apartment, office, and other indoor space.

There are two separate loops filled with water, the ground water loop and building loop (aka secondary loop). The heat exchanger, located in the mechanical room, is the point of division between the two loops. It facilitates temperature exchange between ground water and building loops, while also isolating ground water from the heat pumps and piping of the building loop--to prevent potential sediment problems in the heat pump coils.

The same wells and piping configuration provide heating and air conditioning; water is the heat transfer medium. Compressor cycles in the heat pump units in each apartment or public space make the heat transfers possible. In the winter, compressor cycles of the heat pumps are automatically adjusted to move heat from the water to the indoor air; the now "colder" water of the building loop returns to the heat exchanger where heat from relatively warmer ground loop water is transferred to it again. In the summer, compressor cycles work in reverse and remove heat from the indoor air, transferring it to water in the building loop which transfers it to the ground water loop which takes warmer water back to the wells.

The transfer path for heat in an apartment is as follows:

1. Apartment air circulates through a heat pump, where its differential heat is moved to secondary (building) loop water.
2. The secondary loop water is pumped through the heat exchanger, where it passes its relative heat to water in the ground water loop.
3. This water circulates back through the wells, passing heat to the ground where it is dissipated.
4. Ground temperature in New York City, below five feet down, remains at a steady state of about 60 degrees F.

## **Why Geothermal**

Geothermal systems have several advantages:

- invisible and silent heat exchange;
- no noise and unsightliness of a cooling tower;
- approximately 1/3 more energy efficient than a cooling tower/chiller or a package unit, because the cooling tower water (the primary loop) has water that is 85 to 95 degrees F, whereas ground water in New York City is about 60 degrees F year round. This lower temperature means that less compressor work is required.
- lower emissions than a conventional gas-fired boiler, because electricity in New York is generated by 50% non-fossil fuel based methods. As power plants become more efficient, the emissions associated with the HVAC system at Cedars will automatically reduce as well.
- a life span of 50-100 years, much longer than a cooling tower, chiller, or boiler. The well pumps do require replacement.

## **Financing**

- A NYSERDA pilot program grant based on an overall building energy performance savings of about 30% beyond the NYS's energy code was awarded to the project making it possible to implement many of the sustainability measures. The NYSERDA grant and final design award amounted to nearly one-half million dollars for eight specific conservation upgrades.
- The developer Lantern Group constantly reminds us that the geothermal system would not have been undertaken without the one-million dollar grant to Cedars passed through co-sponsor Friends in the City, Inc., a Quaker group committed to green, environmentally sustainable buildings and renewable energy resources.

## **Construction Process**

- NYS well permit was required, and the general contractor had to establish an escrow account for the owner.
- Water quality tests were required to check for algae and contaminants.
- Water recharge rate tests were required to gauge level of performance.
- Wells were dug at a rate of approximately one per month.

## **Lessons Learned**

- Commissioning the system is critical during and after construction is completed to ensure that all components are in place and functioning properly.
- System should be monitored and balanced over the course of a year to get the full cycle of seasons.
- Facility and property managers should receive basic training in understanding and monitoring the geothermal system.
- We have not found an experienced HVAC maintenance company in or near the City willing, for what we can afford, to take on coordinated management of the ground

source/geothermal wells, monitoring equipment, automated controls and their integrated functioning with the building heat pump and distribution systems.

- During the planning stages, consideration must be given to how these building-wide operations will be monitored and serviced on a regular basis by trained technicians.
- An engineering firm that specializes in, and carries professional insurance for, geothermal design, installation, and maintenance during both construction and operations phases would be an advantage to low-income housing developers who want to take advantage of the efficiencies provided by geothermal heating and cooling systems.

### **Non-geothermal related green measures.**

The following measures were at the heart of Cedars green strategy:

- **Cavity wall system** with 2" air space and 2" insulation for greater insulation
- **Fiberglass frame windows** in lieu of aluminum windows: These windows reduce heat loss/gain by inhibiting conductivity.
- **Condensing boilers** to provide domestic hot water in lieu of standard hot water boilers: Condensing boilers recapture heat from exhaust gasses, raising efficiency.
- **Exhaust ventilation control** at each kitchen using timers on centralized fans to provide service only when it is needed versus running continually.
- **Exhaust ventilation control** at each bathroom with localized fans (versus central fans continually on)
- **Alternating current, direct traction elevators** that eliminate gear power losses, use smaller motors, have variable speed controls, and meet load demands more accurately
- **Bi-level lighting** in common areas, which reduces lighting levels by 70% when there are no occupants
- **Central direct digital controls** for the HVAC system, allowing building manager to monitor energy usage and set limits that prevent extravagant usage
- **Energy Star rated appliances** that perform better than standard
- **Green Roof** that reduces heat island effect and slows water discharge rate
- **Construction materials and equipment** from within a 500 mile radius, specified and installed
- **Recycling** of construction waste material
- **Materials high in recycled content**, specified and installed
- **Low VOC material** with less off-gassing resulting in a healthier environment