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New Strip Mall in Rockford, Ill., Mines Energy From Subterranean Power Plant

Utilizes network of water-to-air geothermal systems

In Rockford, Ill., the owners of a new 12-business strip mall approved a plan for a network of water-to-air geothermal systems piped to a large main serving as a “thoroughfare.” Each system would be able to pull and deposit British-thermal-unit-rich fluids as needed. With a total capacity of 90 tons, the project called for an extensive geothermal-exchange field.

Design/build contractor Area Mechanical started the project with a thorough conductivity test. Nobody was looking to waste money by drilling an oversized exchange field or, worse yet, come up short on capacity with an undersized field.

Sixty-four closed-loop vertical boreholes were drilled in an area now covered by asphalt, the strip mall’s parking lot.

“The geo-exchange field takes up the entire parking lot,” Ryan Kerry, part owner of Great Lakes

Geothermal, the drilling subcontractor, said.

Great Lakes spent three-and-a-half months drilling the boreholes and trenching the lines to the building. Great Lakes also installed U-tubes and filled the boreholes with bentonite grout.

“Boreholes for the Rockford mall average 250 ft in depth,” Kerry said. “We would normally go deeper, but we kept hitting gravel. Most likely, it’s loose conglomerate from an old, now-dormant underground river bed.”

According to Kerry, the soil makeup was well-suited for heat transfer, until the rigs hit the gravel veins.

Loop temperature averages in the low 40s during winter and the 60s to 70s throughout summer. The boreholes were set about 20 ft from each other—a greater-than-average distance—to help stabilize ground-loop temperatures year-round.

For each ton of heating and cooling capacity, there is about 180 ft of bentonite-grout-filled borehole.

“Illinois state code mandates that all geothermal boreholes are grouted,” Kerry said.

To retain all of the energy-efficient heating and cooling, a tight building envelope was designed. The building was heavily insulated, and high-quality, low-E windows were specified. Awnings were installed over all of the windows and doors, and a flat white roof was installed to reflect the majority of the sun’s radiant energy during summer.

On the Inside

The first business to locate in the mall was a Subway restaurant. The 2,800-sq-ft eatery is heated and cooled with two ClimateMaster Tranquility geothermal systems suspended above the finished ceiling. One is a 3-ton TTH038; the other is a 4-ton TTH049. Both are hung from roof trusses.

“Initially, we considered having a primary pumping system with continuous flow through all the wells and all the units, but later discarded the idea, even though we knew there’d be greater overall system efficiency if we circulated fluids that way,” Bill Sprague, project manager for Area Mechanical, said. “But the owner of the building insisted on having the ability to split up the utility bills. A primary pumping arrangement would have allowed for only one power meter.”

“There’s a total of eight circuits, each comprised of eight 2-in. geothermal loops,” Jeff Hurst, geothermal product manager for Connor Co., Area Mechanical’s geothermal-equipment supplier, said. “These are connected, or fused together, in the geo-exchange field.”

Area Mechanical heat-fused all of the geothermal lines. Reverse return piping was used to run each circuit into the building. The tubing starts at 1¼ in. at the first well and steps



The slab for the 12-shop building was poured in August 2009. The geothermal-exchange field needed to be completed by October, which left just enough time for the parking lot to be paved before asphalt plants closed for the year.



Workers install a ClimateMaster Tranquility geothermal system.

up as it joins the other wells. Two-in. tubing is used to run from the last well into the building. On the return side, the same tapering process is used, only in reverse order. This ensures an even draw from each of the eight wells connected to the circuit. The geothermal-exchange medium—1,800 gal. for the entire geothermal field and strip mall—is a 20-percent methanol mix.

“Once the circuits reach the building, they join a 4-in. main, or header, that all the units individually draw from,” Hurst explained. “It’s not a continuously running body of fluid. Fluids circulate only when there’s a call for Btus.”

To ensure heating and cooling costs are distributed fairly, each shop has its own flow center. The flow center is wired to the tenant’s power meter. Each tenant simply pays for its energy use.

“The pump arrangement we ended up using gives each tenant the ability to monitor their own energy use, hopefully making them a little more energy-wise,” Sprague said. “That was the building owner’s intent, and it appears that it’s worked very well.”

Added Hurst: “There was another key advantage for the build-

ing owner: It saved a good deal of drilling expense. Since all the geothermal units share all the holes, each hole is being used to its full

capacity. We were able to save about 20 ft of vertical borehole per ton of capacity on this project because of the way the system is piped.”

The average flow rate for the restaurant’s 7 tons of heating and cooling systems is 3 gpm per ton.

The exchange field feeds numerous ClimateMaster water-to-air units throughout the mall. Not all of the units have been installed yet because not all of the spaces currently are rented.

Information and photographs courtesy of Dan Vastyan, account manager for Common Ground, a trade-communications firm based in Manheim, Pa.

Circle 100

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EVERY SYSTEM NEEDS A GOOD FLUSH

Before antifreeze solution is introduced and equipment is activated, a piped geothermal system is thoroughly flushed to eliminate debris and foreign matter—typically, sand, grout, or plastic shavings that remain in manufactured pipes.

Area Mechanical built its own flushing system. One of its mobile units has a 5-hp gas-powered motor. The other—used for larger commercial systems—has a 7-hp gas-powered motor. Each unit has a 100-gal. poly tank and a filter to catch particulate.

“We must meet the minimum need of 2 fps when flushing, as recommended by IGSHPA (International Ground Source Heat Pump Association),” Project Manager Bill Sprague said. “But with commercial systems, where larger pipes are used, we often need a larger motor and pump to meet the volume we need to push through larger pipes. Our 7-hp unit is well-suited for that.”

“Once we were called in to push debris out of a large geo-exchange field that we weren’t involved with,” Sprague continued. “They couldn’t move the sand and grit out of it with a standard-sized flushing unit. We cranked up our 7-hp unit and got the job done. There were gallons of stuff in the pipe that didn’t belong in there.”

For the strip mall in Rockford, Ill., the entire ground-loop system was divided into eight circuits, each with the equivalent of about 5,000 lineal ft of pipe to clear. The number 5,000 was divided by two (for 2 fps) to obtain 2,500. That number, then, was divided by 60, which told Area Mechanical the minimum number of minutes to flush.

So, for each of the eight circuits: $(5,000 \div 2) \div 60 = 42$.

“We usually double it to be safe,” Sprague said.