Piping Hot (and Cold)

Concrete earth tubes add to LEED certification and energy efficiency.

BY REBECCA SONNENTAG

Aldo Leopold, the noted environmentalist who died in 1948, wrote, “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.” Leopold’s influence was so strong that today he is recognized as the father of American conservation.
So it's fitting that his famous name now graces the exterior of the Aldo Leopold Legacy Center, which was completed last year in Baraboo, Wis. The Center’s LEED Platinum certification from the U.S. Green Building Council (USGBC) recognizes it as one of the most ecologically friendly structures in the U.S. Adopting European design influences, architects utilized some of the most innovative materials and systems ever employed in U.S. commercial construction. And concrete was a key part of its environmentally friendly design.

The best in climate control
One key design feature to this certification is the center’s cutting-edge geothermal climate control system. Its heat exchangers feed radiant floor heat during the winter and supply cooling in the hottest summer months. The system relies on concrete “earth tubes” for ventilation. The tubes underlay more than 5,000 square feet, one-third of which is under the building itself.

County Materials, a producer based in Marathon, Wis., cast 600 linear feet of reinforced concrete pipe, custom air intake manholes, 90-degree bends, and T-beams for the climate control system. The underground conduits comprise a series of connected 24-inch-diameter concrete pipe buried more than 10-12 feet deep. Covered by earthen fill, the air in the tubes is maintained at a steady temperature of about 55°F year-round.

Ambient air enters the underground maze of pipes through the concrete foundation wall. The pipeway is grouted in place with non-shrink, non-metallic grout. “The pipes are transitioned into the supply air ductwork via a sheet metal fitting,” says Gregg Tucek, project manager for the Oscar J. Boldt Construction Co., a leading green construction firm.
"The air then filters through a UV lamp to eliminate mold and bacteria before being heated or cooled and circulated throughout the building."

At the other end, the pipes are connected to a larger vertical air intake pipe extending above the ground. The opening is covered by a metal roof system, and the sides include screening against birds, insects, and debris.

The pipe-to-pipe joints are sealed with rubber gaskets, effectively keeping water out and preventing gases in the soil from leaching into the ventilation system. The pipe itself is permeable enough to allow any water to evaporate that may condense on the inside. Planners selected 24-inch-diameter reinforced concrete pipe because of its thermal properties, ease of installation, and economy, says Joel Krueger, green building specialist and project architect with the project's design firm, Kubala Washatko Architects.

The geothermal climate system requires just the right site, slope, and soil type. The center's sandy site has provided a superb source and sink for heat. Working with the pipe's available surface area, the airflow rate, and the difference in temperature between the air and the ground, calculations determined the change in air temperature entering the building.

Monitoring energy use
Solar panels power the building's heating, cooling, and ventilation systems, a renewable source of energy rather than natural gas or other fossil fuels. More than 500 sensors monitor energy use, temperature, and even carbon dioxide levels in the building to track the Legacy Center's performance and indoor comfort levels.

With rising energy costs, the long-term payback is "a bit of a moving target," says Krueger. "With the concrete air tubes and other consumer reducing systems in place and the photo voltaic producing energy, we can continue to be energy neutral or even positive."

So far, the climate control system has worked as designed. Since opening in fall 2007, the building has saved enough in energy costs that the Aldo Leopold Foundation has earned $650 by selling energy back to the local utility.

With an annual energy demand matched by the output of clean, renewable energy systems onsite, the center is the first "net zero energy" building in Wisconsin and the first carbon-neutral building certified by LEED. TOP

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