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2008 EVERGREEN AWARDS

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NEW WINDOW TO THE WORLD

A Glass Conservatory Redefines the Meaning of Nature Appreciation

Although green-building practices have taken hold in virtually every market sector, construction methods for conservatories haven't changed much since the 1840s. A greenhouse without the greenhouse effect seems like an oxymoron, but the Phipps Tropical Forest Conservatory in Pittsburgh managed to tip convention upside down.

Phipps Conservatory and Botanical Gardens is a nonprofit, 14-room glasshouse public garden originally built in 1893. As the third building in a five-building program, the new 12,000-square-foot (1115-m^2) Phipps Tropical Forest Conservatory was constructed in 2006 to house tropical flora, two waterfalls, a canopy-layer walkway, public gathering spaces and educational discovery areas. It also is the first-place winner in *eco-structure*'s inaugural Evergreen Awards' "ecommercial" category.

A CHANGE OF PLAN

Greenhouses use an enormous amount of resources. Critical for plant growth, abundant sunlight generates immense heat gain. In the summer, vast amounts of energy are required to cool the space. In the winter and at night, a great deal of heat needs to be generated for the plants to survive and maintain comfortable temperatures for visitors. As a result, Phipps administrators decided that maximizing energy efficiency in the conservatory would be the first priority.

According to Richard Piacentini, executive director of the Phipps Conservatory and Botanical Gardens, the team became inspired when the Welcome Center—the first building in the program—earned LEED for New Construction Silver certification from the Washington, D.C.-based U.S. Green Building Council. Although the new conservatory's construction documents already were complete, the team decided to raise its bar and revisit the design.

"We challenged our own assumptions through simple questions like, 'What would happen if we did this?'. It made so much sense once we got going, and the entire team was committed to doing its best," Piacentini says.

UNEARTHING GREEN SOLUTIONS

Many conventional roofs in traditional glass conservatory design use a single high and low vent to create a chimney effect for passive cooling. Pushing their engineers to think outside the glass box, Phipps administrators requested a computational fluid dynamic study to determine if creating vents on every other glass row of the roof was a feasible cooling solution. Opening 50 percent of the roof was a radical concept; traditional conservatory construction vents less than 20 percent of the roof. The study showed the passive concept not only worked, it totally eliminated the need for mechanical ventilation to remove heat from the space.

Earth tubes also became an integral part of the passive cooling system. The team placed six concrete tubes, 24 inches (610 mm) in diameter and 300 feet long (91 m), 15 feet (4.6 m) below grade where the earth holds a constant temperature of 55 F (13 C) year round. Hot outside air is cooled in the tubes, and the vacuum from the roof vents draws the cooled air throughout the conservatory. An average conservatory cooling system costs approximately $750,000 and operates approximately nine months of the year. The price of the Tropical Forest Conservatory's earth tubes was $550,000 and operating costs are negligible.

NEW TECHNOLOGY

Ralph DiNola, an Evergreen Awards judge and principal of Portland, Ore.-based Green Building Services Inc., admired the initiative of the Phipps administration and board. "The ownership team challenged assumptions to bring the project to the next level and incorporate features that hadn't been attempted in this type of design before," DiNola explains. "The team began with a desire to make the most of passive strategies and then truly expanded on the possibilities."

One innovative feature is the inclusion of a solid oxide fuel cell co-generation system that converts natural gas into electricity. The system is a demonstration project in conjunction with Siemens Power Generation, Munich, Germany. The fuel cell is about 70 percent efficient and there is no energy transmission loss. Without combustion, the cell doesn't generate the pollutants commonly associated with traditional heating systems. The cell also reduces carbon-dioxide emissions, and Phipps administrators plan to use plants to sequester what CO_2 the fuel cell does produce.

A computer-controlled fogging system that cools the air and creates humidity for the conservatory's plants requires distilled water, and the conservatory uses excess heat from the fuel cell to create tempered water for the reverse-osmosis

GREEN TEAM

/ ARCHITECT / IKM Inc., Pittsburgh, www.ikminc.com **/ GREENHOUSE CONSULTANT /** Montgomery Smith Inc., Burlington, Ky., (859) 586-6508 **/ GENERAL CONTRACTOR /** Turner Construction Co., New York, www.turnerconstruction.com

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system. Heat from the fuel cell also is used to provide warm water for the tropical plants. The fuel cell is on public display to inspire curiosity and inform visitors about its environmental benefits.

HERE COMES THE SUN

The roof slopes downward from the 60-foot- (18-m-) high wall on the south side of the building. Sun-tracking studies showed that winter sun would enter the building through the south-facing wall but not directly through the roof. To capture the maximum sunlight during winter, the team left the south wall as single-pane glass and chose insulated double-pane glass for the roof to prevent heat loss.

Computer-controlled shade cloths below the roof are tied electronically to a weather station and perform dual functions. When deployed during the day, they protect the plants from too much sunlight. Because the shades are made of Mylar, at night they become thermal blankets that slow radiant heat loss. Root-zone heating allows nighttime temperatures to be lowered by 10 F (5.5 C).

The combination of double-insulated glass, thermal blankets and root-zone heating saves 1,526 million BTUs annually compared with traditional single-pane roof glass. As an added bonus, the ability to shade the conservatory reduces water consumption.

A simulation software energy modeling report by FTC&H Engineers, Grand Rapids, Mich., shows that a similar-sized conservatory of traditional design would incur heating costs of $16,800 per year. The Phipps Tropical Forest Conservatory is predicted to have an annual heating bill of $2,400, and there virtually are no costs to cool the space.

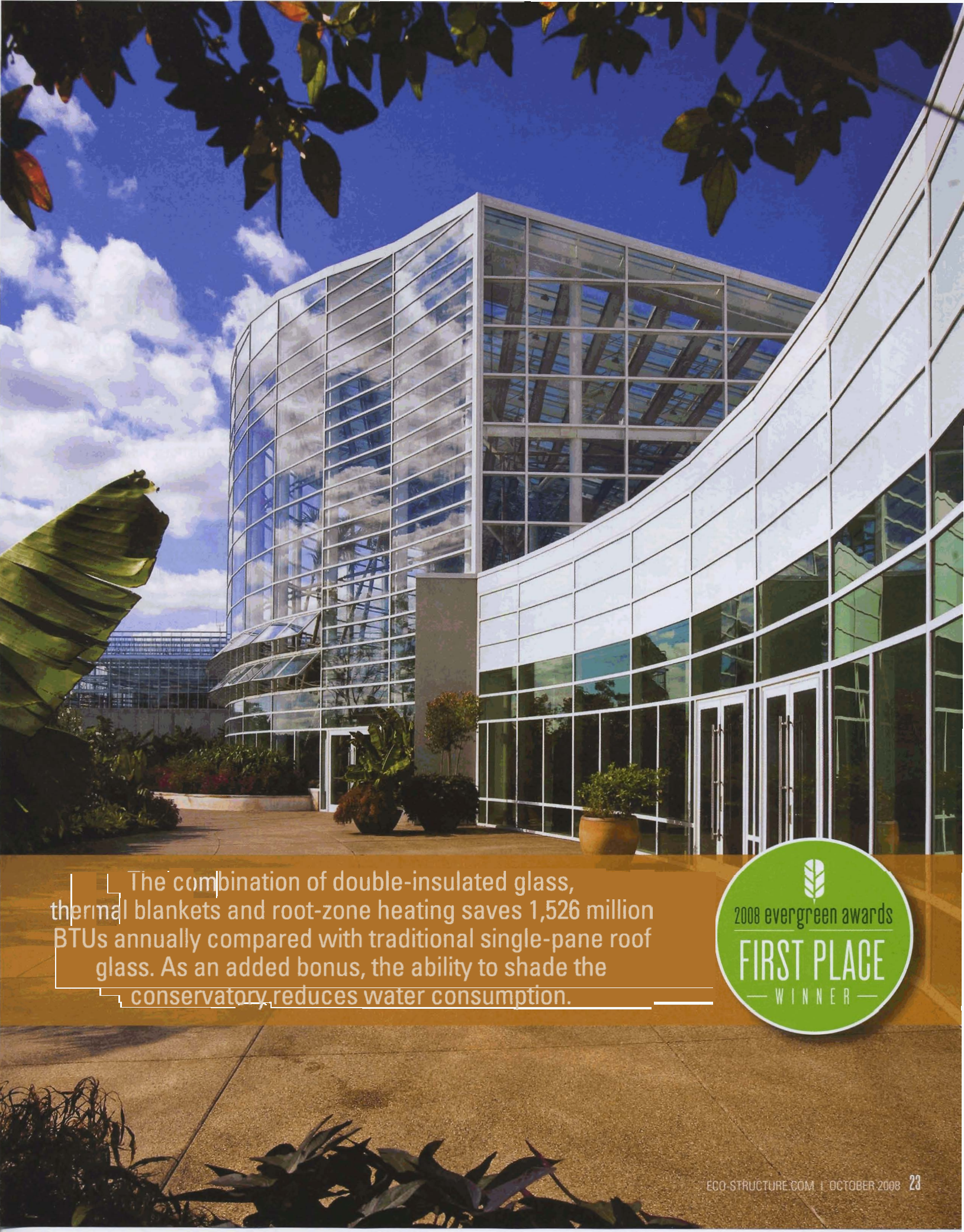
Evergreen Awards judge Tom Glaysher of Flad Architects, Gainesville, Fla., liked how the project integrated many complex systems into a unified whole. "It is at once elegant and innovative, artfully synthesizing a range of energy-conservation strategies. This project is an excellent precedent for those interested in passive and high-tech energy strategies for buildings."

GROWING AWARENESS

As a public building, the state-of-the-art conservatory creates a phenomenal opportunity to educate the 250,000 visitors that visit the garden each year.

"The Phipps Tropical Forest Conservatory is the most energy-efficient conservatory in the world," Piacentini says. "At a time when it's more important than ever to conserve our natural resources, this facility sets a new international standard."

>> KJ FIELDS writes about architecture and sustainability from Portland, Ore.



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2008 evergreen awards
FIRST PLACE
WINNER

MATERIALS AND SOURCES

BAMBOO FLOORING / SMITH AND FONG San Francisco, www.plyboo.com
ROOFING / SOPREMA, Wadsworth, Ohio, www.soprema.us, and FIRESTONE BUILDING PRODUCTS, Indianapolis, www.firestonebpco.com
HVAC / TRANE, La Crosse, Wis., www.trane.com
PAINT / PPG INDUSTRIES, Pittsburgh, www.ppg.com
ENERGY / ARCHITECTURAL ENERGY CORP., Boulder, Colo., www.archenergy.com, and ARGUS CONTROLS, Vancouver, British Columbia, Canada, www.arguscontrols.com
BUILDING / VISTAWALL NATURALITE, Dallas, www.vistawall.com; PPG INDUSTRIES; and VANWINGERDEN, Mills River, N.C., www.van-wingerden.com
PLUMBING / THE WATERLESS CO., Vista, Calif., www.waterless.com; SLOAN VALVE CO., Franklin Park, Ill., www.sloanvalve.com; and SPEAKMAN, Wilmington, Del., www.speakmancompany.com
WATER / CROWN SOLUTIONS, Vandalia, Ohio, www.crownsolutions.com
HUMIDIFICATION / M.E.C. SYSTEMS, Chilliwack, British Columbia, www.mecsystems.com
ELECTRICAL / SIEMENS POWER GENERATION, Munich, Germany, www.powergeneration.siemens.com

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