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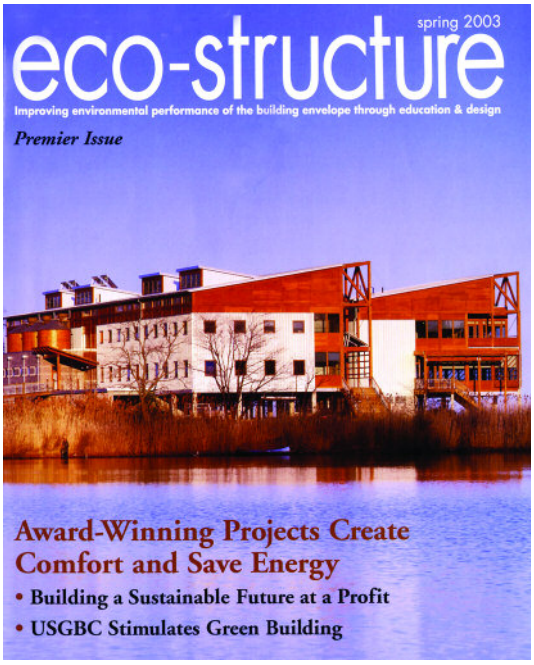
REVISITING THE CHESAPEAKE BAY FOUNDATION'S PHILIP MERRILL ENVIRONMENTAL CENTER



IN 2003, *ECO-STRUCTURE*'S PREMIER ISSUE'S COVER STORY, "Philip Merrill Environmental Center Leads by Example," showcased the first building in the nation to achieve a Platinum rating from the U.S. Green Building Council's LEED program. The center is the headquarters for the Chesapeake Bay Foundation, Annapolis, Md. Washington, D.C.-based SmithGroup's design set out to lead by example, hoping the Philip Merrill Environmental Center wouldn't stay the only LEED Platinum building for long.

Since opening, the center has become a destination—business owners, government leaders, contractors, architects, engineers and the general public have traveled to Annapolis to learn how to build green. The wide embrace of sustainability within the building industry during the last five years suggests the goal of leading by example has been met. But what about the center's more quantifiable performance goals?

BY GREG MELLA, AIA, LEED AP, AND CYNTHIA COGIL, P.E., LEED AP

ENERGY SAVINGS

SmithGroup's design predicted 50 percent less energy use than ASHRAE 90.1-1989, or 23 kBtu/square foot/year, excluding miscellaneous loads, such as exterior lighting and elevators, not regulated by the standard. The National Renewable Energy Laboratory, Golden, Colo., collected energy use data via utility metering and system sub-metering, as well as completed computer simulation from November 2001 to November 2002. Annual energy usage was measured to be 39.9 kBtu/square foot, inclusive of miscellaneous loads like exterior lighting and elevators. The results of NREL's analysis were published in the 2005 report "Analysis of the Energy Performance of the Chesapeake Bay Foundation's Philip Merrill Environmental Center."

The results are 24.5 percent less than a minimally code-compliant building modeled in accordance with Appendix G of ASHRAE 90.1-2001 (a more stringent standard than the 1989 version) and adjusted to reflect actual building weather data, schedules of use, and plug and miscellaneous loads. The results also are 59 percent less than typical office buildings based on 1995 data collected by the Energy Information Administration, Washington, D.C. Through NREL's analysis, Chesapeake Bay Foundation learned its plug loads were the largest energy end-use category, so the organization placed all possible plug-ins, including soda machines, on motion sensors and adopted a policy to purchase Energy Star-rated office equipment. Unfortunately, NREL has not re-monitored the building so no quantitative analysis has been done.

SmithGroup estimated natural ventilation might be used approximately 9 percent of the year when outdoor conditions were between 68 and 77 F (20 and 25 C) and 20 to 70 percent relative humidity. Roger Chang, a graduate student at the Massachusetts Institute of Technology, Cambridge, studied the center as part of his master's thesis and reported his findings in "Case Studies of Naturally Ventilated Commercial Buildings in the United States," 2002. Chang found this estimate to be conservative and, through the use of data loggers, discovered that natural ventilation was used for 34 percent of weekday working hours during a much larger and cooler range of outdoor temperatures.

Because the natural ventilation system is a passive system—employees open windows themselves—there were no maintenance costs associated with natural ventilation. No studies were done to track an increase in the amount of pollen that cleaning crews deal with during the time of natural ventilation. Also, because the monitoring systems will only trigger natural ventilation during times when humidity levels do not exceed 70 percent, there are no impacts on materials that result from excess humidity indoors.

Based on detailed thermal comfort surveys, Chang learned the center's occupants generally favored the use of natural ventilation compared with mechanical conditioning. The survey results also show that occupant thermal-comfort expectations differed between natural ventilation mode and mechanical air conditioning, a fact that could partially explain the greater than anticipated use of natural ventilation at the center.

WATER USAGE

The center's water consumption was another area of study for NREL. Total water usage for one year was 39,937 gallons (151178 L), of which 33,372 gallons (126327 L), or 83.5 percent, were provided by way of rainwater harvesting and reuse. The balance of water usage, 6,565 gallons (24851 L), or 16.5 percent, was supplied by the on-site well. Total water usage at the center averaged 1.25 gallons/square foot/year, markedly less than conventional office buildings' 12.66 gallons/square foot/year according to the BOCA National Plumbing Code. Thus, the center uses less than 10 percent of the water used by a conventional office building.

The water was tested during the digging of the well for permit, and the water quality was found to be suitable for drinking. The water testing recommended water softeners, however. Concerning non-potable water, no additional testing was done. Because non-potable water will not be consumed, there were no requirements for water-quality testing. The health department did, however, require signs that read "Rainwater: Do Not Drink" on every hand-washing lavatory.

How did the Philip Merrill Environmental Center realize such dramatic savings in water consumption? In addition to rainwater harvesting and reuse at lavatories, clothes washers and mop sinks, a big reason is the center's composting toilets, which the foundation reports work better than expected. The Chesapeake Bay Foundation had anticipated the composting tanks would need to be raked once a week, and organic material (mulch) should be added to the tanks every couple of days. This seemed daunting, but the foundation still was willing

to maintain the tanks. Instead of having the facility manager add the mulch, all users are asked to throw a pinch of mulch down the chute after every use. People actually do it, and this approach has worked well for the center.

As an organization devoted to protecting and restoring the Chesapeake Bay, one of the most important validations of the design pertained to storm-water runoff—a critical pollutant source. As a result of water-retention efforts, land restoration and buffer plantings, there is little to no visual runoff from the site to the Chesapeake Bay or Black Walnut Creek during major rain storms. However, no monitoring of runoff has been performed.

COMMISSIONING

The building was commissioned in 2001 when it opened, and several small glitches in the mechanical controls were identified. For instance, the perimeter hydronic heating had not been tied into the mixed-mode natural ventilation controls as the design had dictated. As a result, the finned tube radiators were turning on when the operable windows were opened. The problem easily was solved by adjusting controls sequences.

Beyond formal commissioning, the center's facility manager fine tuned the building systems to be as efficient as possible without sacrificing comfort. By polling staff, the foundation was able to expand the temperature range in which the building could be cooled using natural ventilation while maintaining the comfort of building occupants. The systems in the building were interactive enough to accommodate this adjustment.

In addition, within the first year of operation of the center, the marine-grade plywood that clad a portion of the building's façades began to lip, check and show signs of early deterioration. Through field investigation, the design and construction team learned the plywood had not been sealed on exposed and concealed locations as required causing water and humidity to penetrate the plywood and resulting in the observed deterioration. The deterioration had no impact on energy performance or natural ventilation. The Chesapeake Bay Foundation decided to replace the exterior-grade plywood with fiber-cement panels of a similar R-value. The fiber-cement panels were stained, and the finish closely approximated the look of the plywood. These panels are more durable and moisture resistant and have performed well since their installation.

USER RESPONSE

The Philip Merrill Environmental Center is more than a showroom for green technology; it is home to a staff of nearly 100. Mary Tod Winchester, vice president of administration for the Chesapeake Bay Foundation, states: "The facility is a major recruitment tool. We have a much higher level of job applicants and more applicants per job than before we moved here."

A study conducted by the Center for the Built Environment at the University of California, Berkeley, supports Winchester's praise. It surveyed 25,000 occupants of 150 buildings to question users' satisfaction regarding air quality, comfort, acoustics and lighting. Of the 150 buildings rated, the Philip Merrill Environmental Center received the second highest overall satisfaction score. Lesson: You don't have to lose comfort or beauty to practice the right thing for the environment.

SmithGroup learned a lot from the Philip Merrill Environmental Center, including how elements like the natural ventilation system can work even better than anticipated. While architects and engineers strive to get it right the first time, monitoring performance and remedying problems in a building are equally critical.

Greg Mella and Cynthia Cogil are principals at SmithGroup's Washington, D.C., office. For the Philip Merrill Center, Mella served as project architect, and Cogil was mechanical designer. They can be reached at (202) 842-2100.

MATERIALS AND SOURCES

- HIGH-PERFORMANCE FIBER-GLASS WINDOWS / **Inline Fiberglass Ltd.**, Toronto, www.inlinefiberglass.com
- METAL ROOF/WALLS / Galvalume standing seam roof and batten seam wall siding from **CENTRIA**, Moon Township, Pa., www.centria.com
- STRUCTURAL INSULATED PANELS / R-control from **Team/IBS Inc.**, Winchester, Va., www.rcontrolibs.com
- FIBER-CEMENT PANELS / Hardipanels from **James Hardie**, Mission Viejo, Calif., www.jameshardie.com
- PHOTOVOLTAIC MODULES / **BP Solar**, Frederick, Md., www.bpsolar.com
- HEAT PUMPS / **FHP Manufacturing**, Fort Lauderdale, Fla., www.fhp-mfg.com
- FLOORING / Bamtex Bamboo Flooring from **Wood Flooring International**, Burlington, N.J., www.bamtex.com; Wicanders Natural Cork from **Amorim Flooring North America Inc.**, Hanover, Md., www.wicanders.com; and Marmoleum and Artoleum from **Forbo Linoleum Inc.**, Hazleton, Pa., www.forboflooringNA.com
- BULLETIN BOARD / **Forbo Linoleum**
- COMPOSTING TOILETS / **Clivus Multrum Inc.**, Lawrence, Mass., www.clivusmultrum.com
- LIGHTING / Rondalite by **Linear Lighting**, Long Island City, N.Y., www.marjoy.com/linear_ lighting.htm, and Series 8 by **Finelite Inc.**, Union City, Calif., www.finelite.com
- OCCUPANCY SENSORS AND LIGHTING CONTROLS / **Watt Stopper/Legrand** Santa Clara, Calif., www.wattstopper.com
- MEDIUM-DENSITY FIBERBOARD / Medex and Medite II from **SierraPine Ltd.**, Roseville, Calif., www.sierrapine.com
- PAINT / **McCormick Paints**, Rockville, Md., www.mccormickpaints.com