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Project List

- Chicago Center for Green Technology
- Carnegie Institute for Global Ecology
- Chesapeake Bay Foundation
- Hewlett Foundation
- Natural Resources Defense Council
- Woods Hole Research Center
- Donald Bren Hall
- Gap 901 Cherry

The Chesapeake Bay Foundation's Philip Merrill Environmental Center

General Information

Location	Annapolis, MD
Owner	The Chesapeake Bay Foundation Inc.
Architect	SmithGroup, Inc.
Engineer	SmithGroup, Inc.
Completed	December 2000
Building Use	Commercial office, interpretive center
Size	32,000 SF
Stories	Two
Cost	\$7,500,000 (excluding land cost)
Occupancy	Typically occupied by 80 People, 40 hours per week
Relevant codes	International Building Code International Energy Conservation Code

Mixed-Mode System

Mixed-Mode Strategy	Changeover system. Temperature and humidity sensors located on the exterior of the building determine when the climate is appropriate for natural ventilation. Upon sensing optimal conditions the building management system turns off the mechanical heating or cooling system and turns on modified exit lighting fixtures which notify the building occupants that it is ok to open the windows. Simultaneous to this change mechanical operators open the windows in the clerestory above the second floor to allow a natural draft to begin. Air is then pulled in through the operable windows, rises through the building, and exits through the clerestory.
Natural Ventilation Details	Operable windows on the north (leeward) side of the building are larger than those on the south (windward) side, to promote greater air velocities inside. Inlet windows total approximately 495 ft2, while outlets total approximately 822 ft2. There are a combination of lower windows that can be operated by the occupants, and upper clerestory windows that automatically open.
HVAC System Details	Geothermal heat pumps with a desiccant dehumidification system are used for heating in the winter and cooling in the summer. There are two ventilation fans in the east portion of the building to assist the natural ventilation flow in areas obstructed by the mechanical room and restrooms. The air enters on the east and is exhausted on the north. The fan sizes are 6500 cfm (1st floor) and 2800 cfm (2nd floor), providing an estimated supplementary air change rate 1.025 air changes per hour.
Configuration & Control	The building is arranged in an open plan office with the whole of the office space utilizing the mixed-mode strategy. A total energy management system monitors and controls energy use in the building. The system alerts employees when windows should be opened. Other windows are opened and closed automatically. The system also monitors daylight levels, adjusting electric lighting as needed. There are approximately 60 individual controls for the windows. On the south façade, windows are banked together in groups of four. Hand cranks by Clearline are mounted on the first floor of the building. They operate both the lower windows and another set approximately 15 ft. high. Rain sensors are located on the mechanically opened clerestory windows set to automatically close when wet weather arrives. As of December 2001, the building setpoints were:

Nat'l Vent Available between 61-72°F.

Window use is up to discretion of occupants. Assist fans may or may not be turned on.

Assist Fans Off when indoor temperature < 68°F. On when indoor temperature > 72°F.

Summer Cooling Between 77-78°F.

Humidity is controlled to 50% with a 10% range.

Winter Cooling A/C or NV used when indoor temperature > 81°F. System turned off when indoor temperature < 78°F Humidification off when RH > 68%.

Humidification turned on when RH < 50%.

Building Design Process

Time Line	1997-2000
Design Tools	The U.S. Green Building Council's LEED Rating System was used in setting goals for the project before the design commenced. Benchmarking tours of other green projects and CBF's educational centers were influential in the design. A peer review of the concept design was organized by the Sustainable Building Industries Council (funded by the Department of Energy) and included reviewers from the Maryland Energy Administration, Maryland Department of Natural Resources, World Wildlife Fund and National Renewable Energy Laboratory. An integrated approach to design was used, and in-house engineers worked closely with architects. Air flow predictions made with simplified rules-of-thumb from ASHRAE Handbook of Fundamentals.
Energy Analysis	Designing Low-Energy Buildings with Energy-10 (DLEB/E-10) software was used for energy analysis. The initial design projection that the building would run in natural ventilation mode for 9% of the year was found to be actually 25% of the year after monitoring the building for several seasons.
Commissioning	Project commissioning was provided by SmithGroup, Inc. the designers of the building rather than an independent third-party, as Commissioning Agent. As a result, the contractor felt that the Commissioning Agent could not be a neutral arbiter. The mixed-mode component was one of the easier parts of the commissioning process. The architect credits this to the simplicity of the mixed-mode system as compared to the daylighting and water collection/treatment systems which were more complicated and required changes and adjustments during commissioning.
Code Conflicts	The need to naturally move air from the first floor up to the second floor and exhaust through the roof when windows were open required special consideration due to required fire and smoke separations. To accommodate this, the architects worked with the fire Marshall to install a laser-beam detection alarm in the air slot connecting the two floors triggering the building fire response if smoke was detected moving through the building.
Other Design Issues	Due to a relatively low design fee available for the design of the building the architect wasn't able to perform a full CFD study of the natural ventilation, a process they normally require to confirm intended design performance. Luckily, due to the excellent historical weather records collected at the nearby lighthouse, enough climate data was available to satisfy the designers that simple natural ventilation rules of thumb would result in a well-ventilated building.

Building Performance

Outdoor Air/Noise	Due to the relatively small building footprint on a 32-acre site, outdoor noise and air pollution are not a concern.
Occupant Satisfaction	The University of California Berkeley Center for the Built Environment performed a web-based occupant indoor environmental quality (IEQ) survey at the Chesapeake Bay Foundation. The survey addressed general building satisfaction, general workspace satisfaction, office layout, office furnishings, thermal comfort, air quality, lighting, views, acoustic quality, cleanliness and maintenance, and several other functionality issues. Occupants reported being satisfied or very satisfied with all categories but with more neutral comments in thermal comfort and acoustic quality. Thermally responses showed that occupants often find the building too cool in both warm and cool weather. This dissatisfaction was attributed to a lack of accessibility and control of thermostats as well as stratification of warm air to the upper floor and certain rooms that then result in discomfort. Acoustically the responses showed that the open plan cubicle workspaces were not providing enough privacy for occupants both between cubicles and between the open first and second floor.

Actual Energy Data

Annual purchased energy use:

Fuel	Quantity	Mmbtu	Kbtu/ft2
Electricity	313,000 kwh	1,070	33.4

Natural gas	34,500kwh	118	3.68
Fuel oil	0	0	0
Annual on-site renewable energy production			
Photovoltaics	2,140 kwh	7.3	0.228
Solar thermal	41,000 kwh	140	4.37
Total annual building energy consumption			
Total purchased		1,190	37.1
Total on-site		147	4.6
Grand total		1,330	41.7
Annual end-use breakdown			
Heating	34,5000 kwh	118	3.68
Cooling	64,100 kwh	219	6.83
Lighting	106,000 kwh	362	11.3
Fans/pumps	1,100 kwh	3.75	0.117
Plug/equip	105,000 kwh	358	11.2
Unspecified		273	8.52

Source: DOE high performance building database

Additional Building Features

Sustainable Sites	<ul style="list-style-type: none"> • South-facing exposure. • Takes advantage prevailing winds for natural ventilation. • Minimizes heat island potential through landscaping and exterior material choices. • Minimizes light pollution by using timers on exterior lights.
Water Efficiency	<ul style="list-style-type: none"> • Composting toilets. • Water-efficient appliances. • Native landscaping. • Captures and reuses rainwater. • Uses bioretention filter to treat oil and other pollutants in runoff from the pervious parking area. • 90+% reduction in water use over an otherwise comparable conventional office building.
Energy and Atmosphere	<ul style="list-style-type: none"> • Maximizes daylight with large windows, clerestories, and an open interior design. • Each workstation has a motion sensor that shuts off computer monitor and task lighting. • Luminous sensors control overhead lighting. • Photovoltaic panels on south wall. • Solar hot water panels on the roof. • South façade shaded with large slotted wooden structure, allows winter sun, keeps out summer sun. • Interior blinds on west, south and east facades.
Materials and Resources	<ul style="list-style-type: none"> • Began with "cradle-to-cradle" philosophy (consider what materials can be made into at the end of their useful lives). • Deconstruction, rather than demolition, of existing structures on the site; all materials were auctioned, salvaged, or recycled. • Materials with recycled content (i.e., galvanized siding made from cans, cars, and guns; interior fabrics; and rubber flooring).

- Materials from rapidly renewable or regenerable resources (i.e., cork and bamboo flooring).
- Structurally Insulated Panels (SIPS) in roof and walls.
- Parallel strand timber beams.
- Local sources (over 50% of materials came from a 300-mile radius).

Indoor Environmental Quality

- Natural ventilation is used whenever possible.
- CO2 monitor and automatically controlled operable windows.
- VOC-free paints.
- Natural, non-toxic materials (i.e., cork, linoleum, bamboo).

Project Team

Architect	SmithGroup, Inc. Washington, DC http://www.smithgroup.com
Commissioning & Mechanical Engineer	SmithGroup, Inc. 1825 Eye Street NW, Suite 250 Washington, DC 20006 202-842-2100 http://www.smithgroup.com
Interior Design	SmithGroup, Inc. 1825 Eye Street NW, Suite 250 Washington, DC 20006 202-842-2100 http://www.smithgroup.com
Civil Engineer	Greenman-Pedersen, Inc. 10620 Guilford Road, Suite 100 Jessup, MD 20794 410-880-3055 http://www.gpinet.com
Structural Engineer	Shemro Engineering, Inc. 6902 West Ave Bethesda, MD
Landscape Architect	Karene Motivans PO Box 29 Shephardstown, WV 25443
Leed Coordinator	J. Harrison Architect Annapolis, MD
Computer Energy Modeling	National Renewable Energy Laboratory 1617 Cole Blvd. Golden, CO 80401-3393 (303) 275-3000 http://www.nrel.gov
Contractor	Clark Construction Group 7500 Old Georgetown Road Bethesda, Maryland 20814 (301) 272-8100 http://www.clarkconstruction.com

Additional Information

Awards	<ul style="list-style-type: none"> • USGBC LEED v.1 Platinum Rating (2000). • ASHRAE Technology Award in 2001 (National Capital Chapter 1st Place Award in the Commercial New division). • AIA/COTE Top Ten Green Projects in 2001. • Business Week/Architectural Record in 2001. • AIA Washington, D.C. Chapter in 2001 Award for Excellence in Architecture. • NESEA Green Building Awards in 2003 First Prize: Places of Work. • Building Design & Construction Magazine in 2001 Grand Award, Building Team Project of the Year.
Sources	<ul style="list-style-type: none"> • U.S. Department of Energy High Performance Buildings Database http://www.eere.energy.gov/buildings/highperformance/case_studies/index.cfm • Case Studies of Naturally Ventilated Commercial Buildings in the U.S., Jui-Chen (Roger) Chang, M.S.M.E. thesis, Massachusetts institute of Technology, June 2002.
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