The Chesapeake Bay Foundation Headquarters: The Philip Merrill Environmental Center

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Like a regional sponge, the Chesapeake Bay, the largest estuary in the United States and fourth largest in the world, has absorbed the drippings and waste of much of this century's development in the mid-Atlantic region. With six states (and one District of Columbia) hovering above her watershed and 11,600 miles of coastline, the Chesapeake is bound to collect the surface runoff and effluent of some of the nation's most developed real estate. Not surprisingly, the bay's health has suffered greatly. In 1983 an unprecedented federal and state partnership united as the Chesapeake Bay Program, whose mission was to restore the bay and protect it from and for the 16 million people living within its watershed. Through the 40's and 50's, Maryland hauled several million bushels of oysters a year. Last year the grand total was less than 27,000 (Horton 2005). In fact, despite the 20 years of the Chesapeake Bay Program, the overall health of the bay has not improved. In its 2004 State of the Bay, the Chesapeake Bay Foundation (CBF) reported that the size of the "dead zone" – literally the volume of water where oxygen levels are so low that all but the hardiest of marine life suffocates – has grown to its largest footprint yet. The CBF gave the bay a failing grade of 27 out of 100 in last year's health checkup. Despite this frustrating lack of progress, the CBF persists and perseveres in its mission to restore the bay to its former glory. One of the most visible symbols of CBF's dedication to protecting the bay and its watershed was the construction of its new headquarters overlooking the bay in Annapolis, MD. The building, The Philip Merrill Environmental Center, was the first building in the US to receive a platinum (the highest) certification in the Leadership in Energy and Environmental Design (LEED) program of the US Green Buildings Council. This distinction was based on the aggressively environmentally friendly nature of the building. CBF and the design team opted for "green" alternatives at every possible juncture, resulting in a multi-prong approach to preserving the landscape

Figure 1: The Philip Merril Environmental Center, shown from the bay (USGBC).

and reducing the building's environmental footprint. I will highlight some of the most impressive and innovative features, as the full complement of strategies are too numerous to catalogue in the scope of this paper. Specifically, I will focus on the site planning and preparation, materials and resources utilization, and energy conservation strategies; water saving strategies are briefly discussed in the context of these other areas.

From the beginning, the Philip Merrill Environmental Center was to be an exercise in sustainable planning and construction. In keeping with Maryland's Smart Growth program, CBF determined not to add one pebble to the Chesapeake Bay's hefty burden of supporting the region's development. The Smart Growth legislation, a progressive strategy begun in 1992 and codified in 1997, encourages development in existing centers and discourages new development off the services grid. In this spirit, CBF identified an already developed but unused site, eliminating the need for further bulldozing and aiming to improve upon the existing land use. Built on the former site of the Bay Ridge pool and poolhouse, the new center *actually* reduced the amount of existing impervious surface. Pre-existing structures were dissembled rather than demolished, such that all materials collected were sorted, recycled, and auctioned off when possible. The original concrete foundation was chipped and used for road fill. The driveway to the building is made of gravel, as opposed to impervious concrete, reducing the runoff footprint and contributing to groundwater replenishment. Where runoff does occur, the site has incorporated a system of retention basins to filter out harmful pollutants through restored wetlands. Runoff from the roof is collected in cisterns reserved for fire-fighting, non-potable water needs, and irrigation. The center has also improved the landscape by planting native landscaping, in particular native grasses. Using native plantings not only eliminates the need for harmful fertilizers (particularly damaging in an area suffering critically from nitrogen loading), but also encourages wildlife and helps restore the original ecology of the area. During site prep and construction, only eight trees were cut down and 130 native trees

Figure 2: Mature trees kept, native wetlands planted to filter runoff (USGBC).

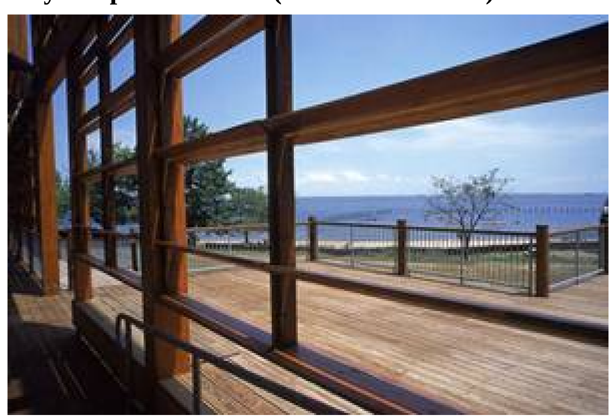
were planted. The parking lot is located under the building itself, reducing impervious surface and also reducing the amount of dark, heat-absorbing surface that contributes to local heat island issues.

Perhaps the most obvious impact a building may have once the site is carefully planned is the materials harvested, manufactured, and transported to build the site. Rather than ship in materials from diverse points, CBF used locally available materials whenever possible. According to the building's LEED scorecard, 51% of materials used were purchased within a 300 mile radius. This philosophy not only provides stimulation for the local economy, it also reduces the consumption of fossil fuels during transportation of materials. The CBF one-upped the environmentally progressive notion of considering the true impact of using certain materials as spanning from the cradle-to-the-grave, whereby a product's environmental footprint is comprised of all the energy and materials used to manufacture, transport, and dispose of the product. The CBF used a "cradle-to-cradle" approach that considers all things from cradle to grave, but then also evaluates a product on how it might be reused once its standard usefulness is outlived. When re-use is not an option, for items that wear heavily, for instance, the center employed biodegradable, renewable materials. The floors and stairs, for example, are made out of bamboo, which renews itself in three to five years, can be grown virtually anywhere, and is entirely biodegradable upon disposal. Similarly, the cork used in some parts of the building's flooring is harvested without killing the cork oak trees, which can regenerate the bark in 7 to 9 years.

In addition to rethinking the use of existing materials and employing more natural, renewable resources, the building utilizes state-of-the-art alternative materials. "Parallel strand lumber" was used for ceiling beams instead of more traditional wooden beams. These beams, commercially called Microlam and Paralam beams, are made by TrusJoist and are a composite of smaller timbers that do not require the harvesting of mature hardwood trees. The wood comes from certified sustainable timber companies, from trees that regenerate quickly enough to be considered renewable. What's more, these timbers, which can be stronger than standard beams and resist warping due to moisture discrepancies, can be made from locally available timbers. The process used to make these timbers uses up to 50% of the harvested tree, whereas standard beams only make use of 40% at best (www.trusjoist.com). New materials were also used to increase the insulation factor of exterior walls while simultaneously reducing the amount of lumber used. Structurally Insulated Panels (SIPs) are used to enclose wall and ceiling areas, providing a much higher degree of insulation and requiring less wood than standard framing techniques. The SIPs consist of an insulating foam core, in this case a non-CFC, recyclable polystyrene, sandwiched between two side panels, in this case, recycled wood particle board. Again, this product is stronger than a frame-and-drywall wall, allowing the design team to span the large interior rooms without needing heavier timbers. To both save money and highlight the innovative materials, CBF did not finish the panels, leaving the exposed surface as testament to the inherently green design. This also eliminated the need for harmful chemical finishes and solvents.

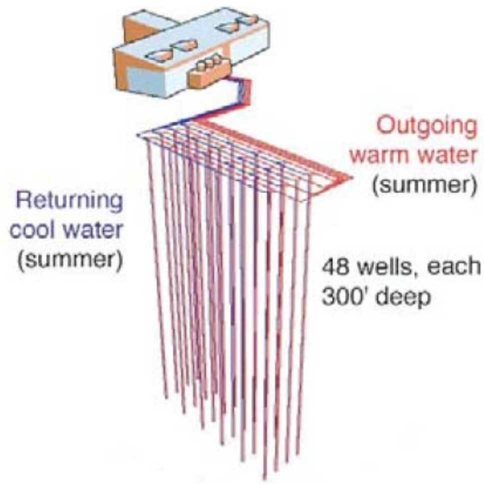
With the advancement of recycling technology, even the more traditional elements of construction use a much higher degree of recycled content than standard materials. The galvanized roofing was entirely recycled from other structures. One of the more creative applications of innovative recycling/reuse is the construction of the external louver shade system out of recycled pickle barrel slats. Perfectly practical for the building, this innovation also saves the barrel materials from the trash stream. Inside, fixtures and features utilize recycled materials whenever possible, such as recycled fabrics and rubber flooring in places. In a “down-to-earth” example of recycling, the center uses composting toilets as opposed to flush toilets hooked up to the sewer grid. Thus, water is saved and the daily human wastes generated are converted directly into good, fertile soil used to fertilize the landscaping.

Figure 3: External louvre system made from recycled pickle barrels (Griffith et al 2005).



With fossil fuel prices soaring and global climate change at the forefront of environmental concern, the designers and CBF were particularly passionate about reducing the building’s energy demands. Buildings consume over 70% of all electricity in the US and contribute 38% of US carbon dioxide emissions (Griffith et al 2005). CBF was determined to exemplify how businesses could incorporate energy-saving technology to reduce energy demands *and* save money in the long run. Their goals can be broken into two categories: supplementing energy supply with on-site alternative energy production and reducing energy needs used. One of the most interesting strategies of supplementing energy supply is the use of ground source heat pumps, sort of geo-thermal sinks, to help cool in the summer and warm in the winter. Pipes drilled deep into the earth send water through parallel pump lines buried below the frostline. In the summer, water is cooled in the subterranean pipes then brought to the surface to cool various zones in the building. Alternatively, in the winter the earth can be used to heat the water up to a certain temperature before additional energy must be employed. The center also draws some of its energy needs from collected solar energy. Much of the energy needed to heat water, for example, comes from four solar collector panels arrayed on the roof. In addition to the solar heat collectors, the southern face of the building is lined with photovoltaic panels that generate electricity for immediate consumption. Overall, the building generates approximately 12% of its total energy demand.

Figure 4: Schematic of ground source heat pump (Griffith et al 2005).



In all applications throughout the building, thought has gone into designing spaces that maximize natural systems. Whereas the ground source heat pumps make use of the earth's natural thermostat, the building's east-west orientation takes full advantage of the sun's rays on the southern wall and full advantage of the predominant winds that come off the Bay.

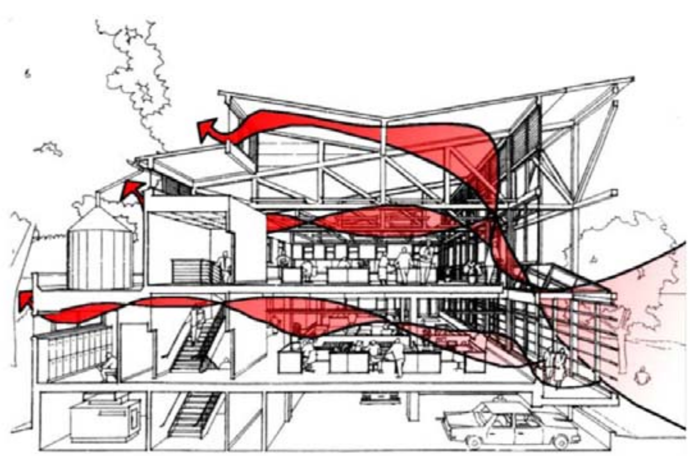


Figure 5: Natural ventilation airflow through building (Griffith et al 2005).

Prevailing bayside breezes are collected on the southern side and channeled through both floors to exit the higher, northern windows. The ventilation and cooling system is monitored by computers that sense conditions and calculate optimal cooling strategies. When appropriate, the system lights up signs indicating that staff can open certain windows to capitalize on the breeze and automatically opens and shuts northern windows to increase or decrease airflow. The long southern wall of windows, in addition to capturing the sun’s warmth in the winter, provides natural lighting throughout the open floor plan. Open office spaces and low walls enable natural and indirect light to disperse throughout the interior. Sensors in the building monitor and adjust artificial lights to maintain an appropriate but minimal amount of light at all times. Occupancy sensors turn lights on and off as needed depending on staffing levels throughout the day, a key factor since lighting consumes over 28% of the average building’s energy budget (Griffith et al 2005).

Figure 6: Natural and artifical lighting in open floor plan (Griffith et al 2005).

Energy saving strategies can only be so effective though, and achieving the lofty goals of the designers has proven challenging. A year-round analysis of the buildings operation in its first year revealed that predicted energy savings were not being met. Although the building uses almost a quarter of the energy a comparable, compliant building would, the savings in dollars is less than expected. In terms of actual money saved, the total was only 12% as opposed to the 50% goal. Granted, a 12% savings is significant, but ideally the green technology would provide a quicker return on the investment (Torcellini et al 2004).

Despite the buildings award winning design and progressive philosophy, there is always room for improvement. The Natural Renewable Energy Laboratories, consultants in the design phase of the building and critical analysts of building performance post-completion, undertook a study six of the nation’s more innovative green buildings to evaluate how well actual performance met design expectations (Torcellini et al 2004).

Though the study finds that the CBF center performs well compared to typical buildings designed for 80 to 100 employees, it also finds that energy savings are less than expected (as were those of the other five buildings in the study). In particular, the ground source heat pumps suffered slightly from inefficiencies imbedded in the operation management programs. Further, the second floor design does not absolutely maximize the amount of natural lighting collected. A second NREL report (Griffith et al 2005) cites another evaluation of the natural ventilation system and finds that cooling efficiency could be improved by tweaking the set controls on automated window systems and coordinating ground source heat pump controls. In addition to these more technologically oriented systems, there have been some issues with the parallel strand lumber beams used. It seems that in some areas where beam faces are exterior on one end and interior on the other, moisture seepage has been a problem. A less-than-watertight building envelope is discouraging when the cause lies in such environmentally promising materials as the Paralam beams, but CBF has addressed these issues sufficiently (Energy Design Update 2005) and the technology continues to improve.

The Philip Merrill Environmental Center is a state-of-the-green-art building and appropriate centerpiece for CBF's efforts to educate and lead by example. The $11.6 million building was an experiment in green design from the planning stage through today's operations, as CBF continually encourages sustainable behavior in its employees. The design team put the plans through a process of peer review amongst green design and construction professionals, uncharacteristic for an architectural process but ultimately productive in focusing the designers on the most cost effective measures to increase the building's green factor. The building cost $199/ft^2 and $46/ft^2 of that was spent directly on environmentally progressive features (USGBC). According to the US Green Buildings Council, this investment will be recouped within seven to eight years through reduced operational costs as a result of these green strategies. As a model for other organizations interested in green construction, that is an encouraging figure. In addition to economic payoffs, a study conducted for the US Department of Energy Building Technology Program found that employee morale and performance were positively influenced by the pride placed in the workspace. The views, light, amenities, and social network in the building made for happy, productive workers (Heerwagen and Zagreus 2005). With favorable economics, improved employee performance, and a truly innovative environmental philosophy, the Philip Merrill Environmental Center stands as a remarkable success in green design. Such success stories, with little to no trade-offs will be the industry leaders that shape sustainable design and construction processes in the future.

Figure 7: Front view of building (Griffith et al 2005).

<u>References</u>

Details and design principles related to the Philip Merrill Environmental Center are available on both the CBF website (http://www.cbf.org/site/PageServer?pagename=about_merrillcenter_index), and the USGBC case study website (http://leedcasestudies.usgbc.org/overview.cfm?ProjectID=69).

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