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A Children's Museum Goes Green:

The Path to LEED Certification

By Paul Pearson

On August 29, 2002, a crew of four worked through the night on the grounds of the Brooklyn Children's Museum, carefully monitoring the flow of groundwater from a 340-foot-deep test well. At dawn, the pump was opened to full volume. Over the next two hours, the aquifer supplied a steady flow of 57-degree groundwater at a rate of over 300 gallons per minute. The good news quickly spread to everyone involved in the museum's capital expansion project—staff, trustees, the architect, and officials at New York City's cultural and construction agencies. The proposed geothermal heating and cooling system, the key to creating a high-performance, certified "green" building, had found its energy source in the groundwater beneath the museum.

In 1899, the Brooklyn Children's Museum, the world's first museum for children, opened in a Victorian house in a Crown Heights park. The institution's "back yard" and its natural history collection supported an early focus on teaching city children about the natural world. In 1977, the museum opened a new, environmentally themed underground building on the same site.

Today, the Brooklyn Children's Museum is positioning itself for the future with an expansion that will double our size and attendance capacity over the next three years. World-renowned architect Rafael Viñoly has designed the 102,000-square-foot expansion/renovation—an undulating, two-story, daffodil-yellow addition that will wrap around the existing facility.

Conservation technology

Increased visibility, visitor amenities, and educational/exhibition space were central goals of the expansion project. But equally critical to an institution with a mission to "foster children's understanding of science, the environment, and world cultures" were environmental considerations and innovative use of new building technologies.

High-performance features integrated into the expansion design will save an estimated $100,000 in annual energy costs. The geothermal heating system will feed water-to-water heat pumps for the building's heating and cooling needs, dramatically reducing on-site burning of nonrenewable fossil fuels and emissions of airborne pollutants. It will also eliminate the need for massive on-site cooling towers, thereby lowering our acoustic impact on the surrounding residential community. Photovoltaic panels integrated into the exterior fabric of the new building will harness sunlight to provide about 2.5 percent of the museum's electricity needs.

Computerized climate control systems will further reduce energy use. Sophisticated carbon dioxide and occupancy sensors will monitor the exhibition spaces, automatically adjusting ventilation and lighting to the number of visitors in the space at any given time. Photoelectric cells will be tied to indoor lighting systems that dim when natural lighting provides sufficient illumination, and brighten during cloudy and nighttime conditions.

Student Museum Team members join Brooklyn Children's Museum president Carol Enseki (center front), architect Rafael Viñoly (top right, with glasses), and other officials at the 2002 unveiling of Viñoly's design. Inset: The planned expansion.
Images courtesy Brooklyn Children's Museum

Selecting energy-conserving and sustainable building materials will add even greater benefits. Low-emissivity glass, coated with a material that keeps the building cooler in summer and warmer in winter, will be used in place of conventional window glass. Structural and finish materials with high levels of renewable or recycled content—including bamboo, cork, rubber and linoleum flooring and recycled carpet—are being used throughout.

High-performance design

Brooklyn Children's Museum's new building is on track for certification by the Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council as the first "green" children's museum in the nation. LEED is a points-based rating system that assesses the environmental

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sustainability of building designs. Criteria include site development, access to public transportation, water conservation and energy efficiency, materials selection, indoor environmental quality, and building commissioning process.

Balancing environmental considerations and economic constraints can pose a significant challenge to tight capital budgets. To help inform our decisions, our "high-performance design" consultants used sophisticated computer programs to simulate various energy-modeling scenarios. The models showed that green building choices typically translated into slightly higher initial capital costs, but that operational savings would begin to accrue long-term when the more efficient systems went online.

The New York City Department of Design and Construction, which oversees municipal construction projects, alerted our capital expansion team to two local resources available to organizations considering "going green": (1) The New York State Energy Research and Development Authority offers cost-shared technical assistance and financial incentives through its New Construction and Green Buildings Programs, and (2) the New York Power Authority finances energy-efficiency projects for public buildings statewide through its Energy Services Programs. Both of these agencies have helped the museum fund high-performance components of our expansion project.

A teaching opportunity

For Brooklyn Children's Museum, the decision to "go green" was well aligned with our educational mission and focus on science and the environment. Although many of the high-performance elements of our building would not be visible to the public, we recognized that the project afforded a unique teaching opportunity.

When our expansion is complete in 2006, visiting children and families will be able to investigate the concepts and processes of energy efficiency and environmental conservation through an *Energy Exploration* interactive exhibition. An outdoor area will demonstrate how the museum harvests its solar power, and children will be able to manipulate materials and systems to engineer their own model buildings using high-performance design. Visitors will also learn about renewable resources like bamboo—chosen for our new flooring because it is one of the world's fastest-growing plants.

For many years, children's museums and science centers have provided innovative programs in environmental education for youth and families. Brooklyn Children's Museum hopes that a successful project will encourage other informal learning centers to invest in sustainable, environmentally friendly design for their new buildings. ■

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Green Design: A Technical Primer

By Adam Trojanowski

From its planning stages, the Brooklyn Children's Museum project embarked on a comprehensive effort to optimize energy consumption, water conservation, indoor air quality, and utilization of sustainable materials. This was achieved by choosing a building form and plan that is complementary to the site and solar orientation. Mechanical, electrical, and plumbing systems were evaluated in detail to select the most appropriate and efficient systems. The new building also incorporates products and materials that are renewable and recyclable and have low gas emissions.

Ground-source heat-pump system

A new geothermal heating and cooling system provides all the heating, ventilation, and air-conditioning requirements for the museum. The system consists of large, custom heat-pump air handlers, water-to-water units, and heat-pump console units with groundwater as heat-rejection and heat-source medium. To ensure redundancy, groundwater is derived from two 340-foot-deep supply wells with submersible pumps, and is returned to ground through two injection wells. The system offers significant improvement in energy efficiency compared to traditional chiller and boiler systems, plus additional benefits like elimination of rooftop equipment and associated noise issues; elimination of water treatment and plume problems for cooling towers; and overall space savings for mechanical equipment.

Photovoltaic system

Photovoltaic (PV) systems directly convert solar energy into electrical power. The project incorporates 4,700 square feet of vertical panels and 1,000 square feet of roof-mounted panels that will generate approximately 54,000 kWh per year—equivalent to the annual consumption of five households. Electricity generated by the panels will feed directly into the building's electrical system.

Water conservation

Significant reductions in potable water use will be achieved by careful selection of water-conserving plumbing fixtures, equipment, and fittings. Lavatory faucet flows will not exceed 0.5 gpm and are equipped with auto-shutoff sensors. Waterless urinals are utilized in all toilets. New and existing exterior landscaping maximizes indigenous, drought-tolerant plantings to eliminate the need for a permanent irrigation system.

Exterior envelope

The building's exterior envelope has been optimized to provide a high level of thermal and solar protection. All glazing is specified with a U-value of 0.29 and shading coefficient of 0.49. The exterior walls and roof utilize R-20 and R-30 insulation, respectively. The architectural tile wall and roof exterior reflect a high percentage of the sun's radiant energy, resulting in lower cooling load.

Sustainable materials

The new building utilizes large amounts of sustainable materials that reduce depletion of finite raw materials and contribute to improved indoor air quality. The extensively used bamboo flooring is an example of a rapidly renewable material. Adhesives, paints, carpets, and composite wood products and materials were selected to minimize off-gassing of odorous or potentially irritating air contaminants.

Adam Trojanowski is an engineer with ARUP Associates, a provider of technical and design advice for the new Brooklyn Children's Museum building.

For more information on "green design" and LEED certification, visit the U.S. Green Buildings Council web site: www.usgbc.org.