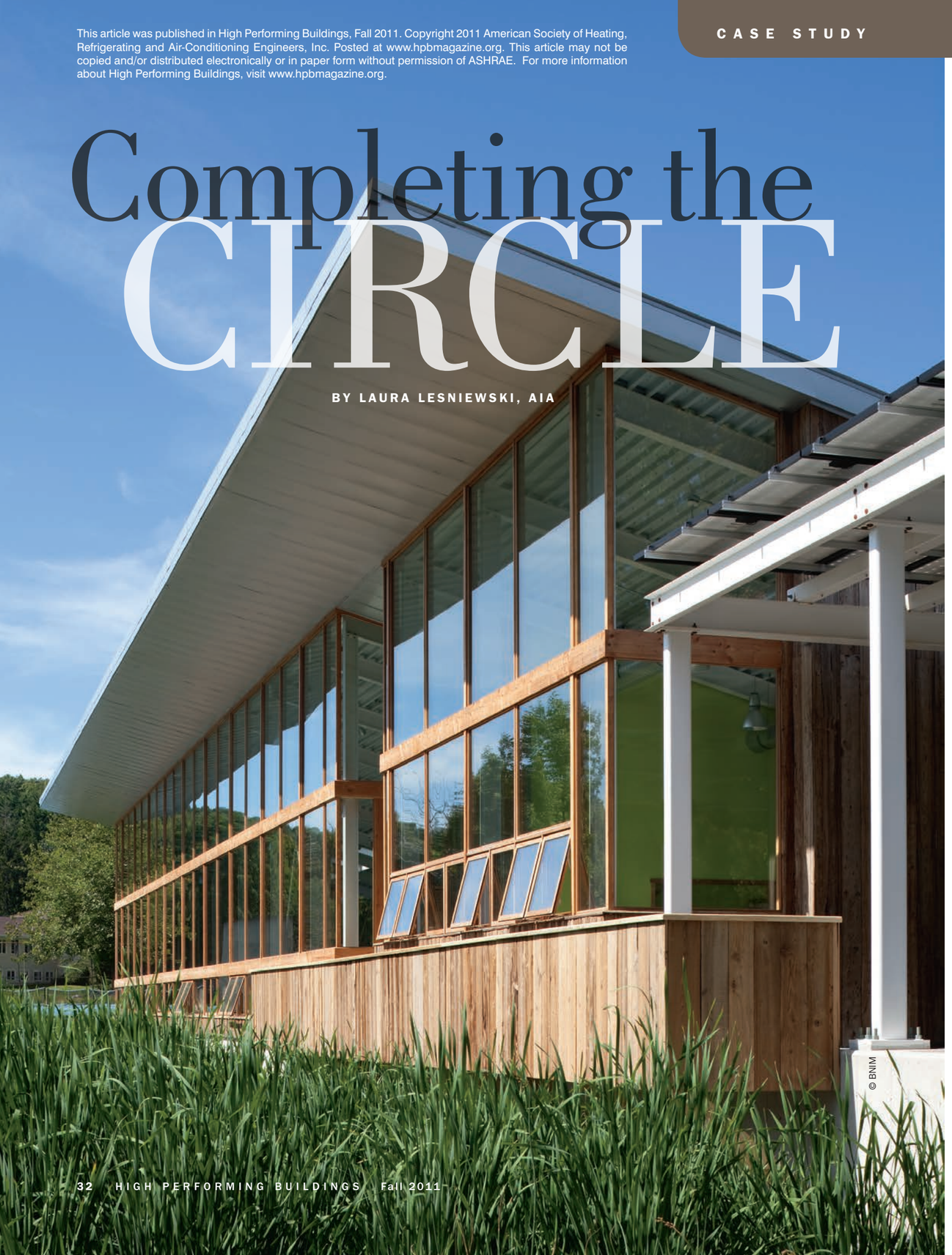
Completing the CIRCLE

BY LAURA LESNIEWSKI, AIA



The Omega Institute for Holistic Studies is the nation's largest holistic learning center. Its mission is: "To look everywhere for the most effective strategies and inspiring traditions that might help people bring more meaning and vitality into their lives." It embarked on a journey in 2006 to develop a new and sustainable wastewater filtration facility for its 195-acre campus, which is located in upstate New York within the 13,400 square mile Hudson River watershed basin.

The primary goal for this project was to overhaul the organization's current wastewater disposal system for the entire campus (more than 100 buildings) by using an alternative method of treatment. As part of a larger effort to educate its visitors, staff and local community on innovative wastewater strategies, Omega decided to showcase the system (or Eco Machine™) in a building that houses the primary treatment cells and a classroom/laboratory.

Soon after committing to pursuing the Living Building certification (see *Living Building Challenge* sidebar on Page 40), CEO Skip Backus named the facility Omega Center for Sustainable Living. In addition to using the treated water for garden irrigation and ultimately in a greywater recovery system, the Omega Institute will use the system and building as a teaching tool in its educational program designed around the ecological impact of its system. These classes are offered to campus visitors, area school children, university students and other local communities.

The building has been in operation since May 2009, and met the Living Building requirements one year later (after the verification period). It is the first building to receive LEED Platinum and Living Building certification.

Think Globally, Act Locally

As with many other parts of the world, water is a critical issue for the region. The Omega Campus is located adjacent to Long Lake, which is part of a tributary system of the Hudson River. Both the lake and the river are facing challenges caused by human activities. Because of its proximity to New York City, the Hudson is a vital source for fresh water. The neighbors surrounding Long Lake (including Omega prior to the construction of the Omega Center) are causing degradation of the lake via agricultural runoff, landscaping

Opposite With goals of net zero energy and net zero water, the design of the Omega Center for Sustainable Living relied on deep connections to nature, from building form and orientation to water cycles and site restoration.

BUILDING AT A GLANCE

Name
Omega Center for Sustainable Living

Location 150 Lake Drive, Rhinebeck, N.Y. (100 miles north of New York)

Owner
Omega Institute for Holistic Studies

Principal Use Wastewater treatment facility

Includes Educational classroom

Employees/Occupants One part-time teacher; one part-time facility staff; part-time tours and classroom students

Gross Square Footage 6,250 ft^2

Conditioned Space 100%

Distinctions/Awards First building to be LEED Platinum and Living Building certified

Total Cost $4.1 million, including cost of outdoor constructed wetlands and full wastewater treatment systems

Substantial Completion/Occupancy
May 2009

ENERGY AT A GLANCE

Annual Energy Use Intensity (Site)
20.3 kBtu/ft^2

Renewable Energy (Produced)
25.3 kBtu/ft^2

Annual Net Energy Use Intensity
–5 kBtu/ft^2

Heating Degree Days 6,008

Cooling Degree Days 1,176

WATER AT A GLANCE

Annual Water Use 0 gallons (municipal)

chemicals, septic systems and urban water issues.

Omega envisioned the project as a means of thinking globally and acting locally. This began with the decision to clean up and build on a former dump (created by a previous owner of the Omega campus) to ensure that leaching or other threats to the aquifer ceased.

The natural systems approach of reclaiming water and returning it clean to the local water system directly reduces the water footprint of every campus visitor, improves the aquifer and Long Lake locally, and has similar impacts upon regional and global water supplies.

The Omega Institute hosts regular educational sessions with leaders on regional and global water issues. Multi-day programs take place in the building, such as: "Ecology by Design," "Grow Food Everywhere," and others focused on water. Since July 2009, Omega staff have given building tours to visitors, to educate

Careful analysis of lighting needs for the plants in the Eco Machine informed the building roof slope, glazing locations and specifications. The indoor lagoons are one of the last stages in the treatment train before the purified water is reintroduced to the water table.

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Above **Four distinct cells make up the outdoor constructed wetlands, just south of the building. Campus wastewater enters these wetlands early in the cleansing process. This nutrient-rich water ensures a robust landscape for the southern view from the building.**

Right **A close-up view of one of the three building photovoltaic arrays with the wetlands and southern façade of the building beyond.**

them on the specifics of the building's design and construction, as well as the critical state of water in our society. More than 50 tours or classes have been given to county, state and federal agencies. Further, the building is open every day and has a constant stream of visitors, including 100 to 150 people per week joining scheduled tours.

Water

The facility is designed to process 52,000 gallons per day of wastewater generated by residents, visitors and staff. Since the population at the Omega Institute is highly seasonal in nature (primarily April through October), flows vary considerably throughout the year, and a robust treatment system was required. In conjunction with this, measures are in place throughout the campus to minimize water use in all campus buildings.

Water supply to the building is provided directly from the groundwater via wells on campus. Prior to construction, water was drawn from the wells, used for human activities (washing, toilet-flushing, drinking fountains, etc.), then piped to a septic/leach field system. The new Eco Machine returns a higher quality of water back to the earth using natural systems that see our waste as food. Aerated lagoons in the building, one component of the system, are on display, carrying greywater through the reclamation process.

As noted, this system is designed to handle peak flows. It is also designed to have flexibility for low flows during the winter. During big rains, when additional rainwater is captured in the wetlands, the pump floats are modified to slow water down to the lagoons. The analogy of wetlands as natural flood attenuators is appropriate. Water is in the system for a period of days (not hours), so fluctuations in the flow and strength can be absorbed.

For potable water uses, well water is still drawn. For toilet flushing, rainwater is collected from the building's roof. Low-flow plumbing fixtures have been installed to minimize water consumption, including waterless urinals in the men's restroom. For all other water use on campus, black and greywater is sent to the Eco Machine lagoons and constructed wetlands for purification. By the end of this cycle, cleaner water is reintroduced to the groundwater and lake using natural systems.

LIFE OF WATER

The vision for this facility was to close the loop on water. All water that is used in this building and in all other buildings on campus comes from the sky or from on-site wells, then is returned to the water table after purification.

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The architectural expression of materials is simple and honest, revealing the uniqueness of each component. This wood rainscreen is salvaged cypress siding.

BUILDING TEAM

Building Owner/Representative
Omega Center for Holistic Studies

Architect BNIM

General Contractor
David Sember Construction

Mechanical Engineer BGR Engineers

Electrical Engineer BGR Engineers

Energy Modeler BGR Engineers

Structural Engineer Tipping Mar

Civil Engineer Chazen Companies

Environmental Consultant
Wastewater Design:
John Todd Ecological Design
Wastewater Engineer:
Natural Systems International

Landscape Architect
Conservation Design Forum

Lighting Design BNIM, BGR Engineers

LEED Consultant EME

Energy

Achieving net zero energy required a design that eliminated wasteful energy use and maximized the use of renewable energy resources. The building is purposely compact, organized to harvest daylight, passive heating, and cooling breezes to reduce energy needs. The insulated thermal mass of the building, and the thermal mass of the water (55°F) passing through the treatment cycle, are instrumental in reducing demands upon mechanical systems. During summer, the cool (relative to outdoor temperatures) lagoon water has a cooling and drying effect on the hot, humid air entering the building. Geothermal wells and heat pumps are used to provide heat for all spaces. Cooling is only provided for the classroom.

Sunlight is the primary lighting source. The shape of the building is designed to harvest sunlight using windows, skylights and shading devices to produce appropriate, comfortable lighting without adversely affecting air temperatures.

Electric lighting systems are efficient and controlled to be used only when conditions mandate supplemental light.

TOTAL ELECTRICITY USED (FIRST 12 MONTHS)

	kWh
Jul 09	2,355
Aug 09	1,770
Sep 09	1,415
Oct 09	2,033
Nov 09	2,833
Dec 09	6,028
Jan 10	5,032
Feb 10	6,752
Mar 10	1,794
Apr 10	1,626
May 10	2,213
Jun 10	3,338
	37,190
Total Metered PV Generation	**46,305**
Net Annual Electricity Generation	**9,115**

Photovoltaic panels generate more energy than the building uses annually, making this a net zero energy building. The excess energy is returned to the local utility. During evenings and certain winter periods, energy is provided by the electric utility. Utility bills for the first year of occupation confirmed that the building is producing more energy than it requires.

Light/Air

Daylighting, natural ventilation and views are achieved through a system of operable, fixed and solar tracking fenestration. Operable windows are provided in each occupied space for both the health and enjoyment of guests, in addition to being part of the passive heating and cooling strategy for the building. Eco Machine plants remove CO_2 and other gases while producing oxygen—indoors and outdoors. Clerestory windows ventilate the lobby, mechanical room and restrooms. Solar radiation heats the upper volume of air, and then natural buoyancy induces stack ventilation, which causes the air to push its way out of the open windows and pull in fresh, cooler air from lower windows in these spaces. Operable windows integrated into the south façade also allow for natural ventilation to assist in pushing hot air out of the building by channeling prevailing breezes that have been cooled while moving over the wetlands.

Building and site are integrated as a single system. The landscape produces a microclimate of clean

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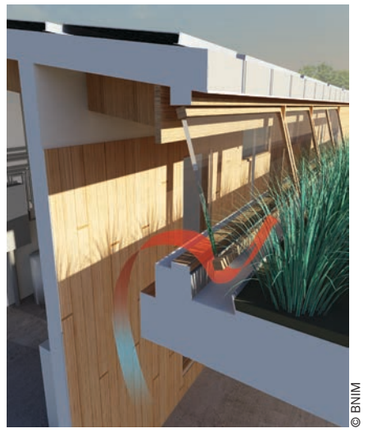

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Above **Air Flow: Clerestory windows help ventilate the lobby, mechanical room and restrooms. Solar radiation heats the upper air, then natural buoyancy induces stack ventilation, causing the air to push its way out of the open windows and pull in fresh, cooler air from lower windows.**

Below **View of the Omega Center for Sustainable Living from the south.**

BUILDING ENVELOPE

Roof
Type Ventilated metal and membrane
Overall R-value 22
Reflectivity 74% and 78%

Walls
Type Cast-in-place concrete and wood frame with reclaimed wood siding
Overall R-value 19
Glazing percentage 54%

Basement/Foundation
Slab edge insulation R-value 15
Under slab insulation R-value 15

Windows
U-value
South Facing 0.32
North, East, West Facing 0.30
Solar Heat Gain Coefficient (SHGC)
South Facing 0.70
North, East, West Facing 0.37
Visual Transmittance
South Facing 79%
North, East, West Facing 70%

Location
Latitude 41° 55' 36"
Longitude –73° 54' 45"
Orientation South

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Above **A detail of the photovoltaic array at the building's outdoor classroom. More than 100% of the building's annual energy needs are supplied by renewable sources.**

Left **In addition to its role as a wastewater treatment facility, the building includes space for yoga instruction to restore the human body and spirit.**

KEY SUSTAINABLE FEATURES

Water Conservation low-flow fixtures, flushless urinal, Eco Machine, rainwater is collected and used to flush toilets

Recycled materials
Incoming steel (structural, concrete reinforcement, roof), glass
Outgoing 99% of construction waste materials were recycled: metals, cardboard, polyisocyanurate insulation, and wood

Daylighting natural light in all occupied spaces, staged lighting controls

Individual controls switched at each space

Other major sustainable features
reclaimed wood siding, plywood sheathing, and lumber framing; passive solar heating, geothermal heat pump, photovoltaic generation

SECTION PERSPECTIVE

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The primary flows of the building—air, energy and water—are illustrated in this section perspective that shows photovoltaic collectors, green roof, constructed wetland, aerated lagoons and daylighting strategies.

Inset top right **Air Flow: The façade is clad with a wood rainscreen, allowing the building to breathe. Operable windows allow for natural ventilation by channeling breezes that push hot air out of the building through north clerestories.**

Inset bottom right **Water Flow: The Eco Machine carries greywater through a reclamation process where it will be scrubbed by plants and microbes and ultimately released back into the water table.**

air and beauty beneficial to the occupants. Water from the building feeds the plants and other living systems of the landscape. The two are visually connected by the transparency of each indoor space.

Material Reuse

The architectural expression of materials is one of simplicity and transparency and is influenced by the colors and textures of the region. No effort was made to mask the underlying nature of a material, but rather to express its beauty. As a pedagogical and practical measure, interior finishes were reduced or eliminated. This approach helped reduce the overall embodied energy of the building and minimized potential off-gassing from various construction materials.

The facility is a showcase for salvaged materials and demonstrates how easily any building can take advantage of material reuse. Reclaimed materials used on the project include dimensional lumber, plywood, interior doors, exterior wood siding, beech wood paneling and toilet partitions. (Materials came from warehouses, schools, office buildings and other projects). All installed wood is either from an FSC Certified forest, or a reclaimed source, including the plywood roof and wall sheathing, which was salvaged from the 2009 U.S. Presidential Inaugural Stage. Materials were also sourced to avoid those on the Materials Red List from the Living Building Challenge Guidelines.

During construction, 99% of metal, cardboard, rigid foam and wood scraps were recycled. 100% of food waste was composted, and 100% of glass, paper and plastic packaging waste were recycled.

LIVING BUILDING CHALLENGE

Created by the International Living Future Institute in 2006, the **Living Building Challenge** endeavors to go beyond requirements in other certification programs in seven performance areas: site, water, energy, health, materials, equity and beauty. Three projects have been certified so far, with 80 projects registered. The Living Building Challenge certification is based on actual performance, and, therefore, a project cannot be evaluated until it's been operational for 12 months.

Four typologies exist for the Challenge: renovation, landscape or infrastructure (non-conditioned development), building and neighborhood. Each performance area has 20 imperatives including net zero energy and water, social justice, urban agriculture and biophilia. The imperatives can be applied to most projects anywhere in the world.

The Omega Center is the first building to receive both Living Building and LEED Platinum certifications.
For more about the Living Building Challenge, visit https://ilbi.org/lbc.

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The Eco Machine is on display for all to see, along with educational signage that provides information about the water purification process from toilet to groundwater.

Project Costs

Project costs were $4.1 million, of which $2.6 million has been raised to date through donations from individuals, foundations, and government (New York Dormitory Authority), and the balance is provided by an institutional loan. NYSERDA (New York State Energy Research and Development Authority) granted Omega an interest rate write down on its institutional loan as well as a subsidy that reduced the cost of energy-savings equipment incorporated into the building. ●

LESSONS LEARNED

Many of the lessons are a result of pursuing the Living Building Challenge and many others are products of the nature of the facility. A new lesson from this project involved the complexity of finding materials that not only met the Materials Red List (developed by the International Living Building Institute to minimize/eliminate the most offending toxic materials from our buildings), but also met radius and responsible industry requirements, and were affordable for the client.

The team's approach was an intuitive, scientific and experiential process. Concepts were modeled using scientific tools to measure comfort, energy, daylighting and other metrics. The team collaborated and relied upon the findings of the modeling to develop an integrated, high performance design for the building and site. One example was using water as a tempering element to improve comfort and reduce mechanical system capacity. The daylight and energy models are proving to be accurate, as evidenced by the compatibility of actual energy needed in the building and the energy provided by the solar panels, as well as the health of the plants in the lagoons.

With regard to the flow rates into the lagoons inside the building, the team learned that if the water levels rose too quickly, the coir fiber mats in the plant racks of the lagoons would soak. This seemed to set off a hatch of "filter flies," which are a nuisance inside the building. This problem is addressed by monitoring and limiting flow rates into the lagoons.

Careful monitoring during the first year of occupancy ensured that the design goals for net zero energy were achieved. Without this kind of scrutiny, many buildings do not hold up to their original energy goals. Its rigorous one-year performance verification period commenced in May 2009; operations were carefully monitored and evaluated by the International Living Building Institute.

ABOUT THE AUTHOR

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