

Living Building Education: The Evolution of Bertschi School's Science Wing

Bertschi School is a place defined not only by its physical being, but also by its community of purpose. As an independent urban elementary school that purpose has been developed and honed by every student, teacher, administrator, and board member that has spent time here over the school's 37-year history. Today that purpose and place are defined in the mission and values of the school and embodied in the curriculum and campus. The recently certified Living Building Science Wing fits well with the place that is Bertschi School.

PHOTO: BENJAMIN BENSCHNEIDER

“If you don’t know where you are, you don’t know who you are.”

—WENDELL BERRY

Located on a half city block in a dense Seattle residential neighborhood, Bertschi School’s 40,000 square feet of built space is comprised of seven structures; four houses and a church building all built in the early twentieth century, the 2007 Bertschi Center, and the 2010 Living Building Science Wing. On this snug campus, every space is used to its fullest. For students and parents the campus is welcoming and comforting. For faculty and staff it supports the educational program in sometimes unusual and unexpected ways made possible by the intimate nature of the campus.

Prior to the Living Building addition, the 2007 completion of the LEED Gold Bertschi Center building and site improvements made room for enhanced art, music, and physical education programs. As new construction, it presented an opportunity for building sustainably that the school was ripe for since the curriculum already supported many of the ideas that were realized in that LEED Gold certified building. The new gym and playfield spaces that were part of this development also freed up the paved ball court on the other end of the campus to become the site for the new science wing.

CURRICULUM INTEGRATION

The Living Building Science Wing is a project that fits perfectly into the school’s long history of sustainable curricula. For nearly fifteen years, the school has taken an active role in making environmental education and sustainable practices core educational values. In each grade level, students focus on a year long investigation of topics. Third grade studies waste and recycling, fourth grade studies water, and fifth grade studies energy. These lengthy study units allow the students to explore many facets and gain an understanding of environmental issues. This unparalleled and inspiring commitment to sustainability education is what initially brought the design team to Bertschi School. Beyond simply reading about these issues, their new Living Building allows the students to experience sustainability on a daily basis. From watching the collection and treatment of water in the building to understanding how their choices influence their energy needs, each student plays an active role in practicing ecological concepts.

The performance aspect of the Living Building Challenge presented a wonderful opportunity for student involvement with the building as part of the certification process. The fourth and fifth grade water and energy studies fit well with tracking the performance of the building during 12 month occupancy stage that is required for Living Building Challenge Certification. The building has been, and continues to be a part of the Bertschi sustainability curriculum because the Challenge requires ongoing monitoring of water usage and treatment, energy, and air quality. No other green building standard is as action based, requiring the users of the building to be a continuous part of its performance and habitability. No other green building standard lends itself so readily to learning about sustainable practices in a concrete manner that even young students can understand.

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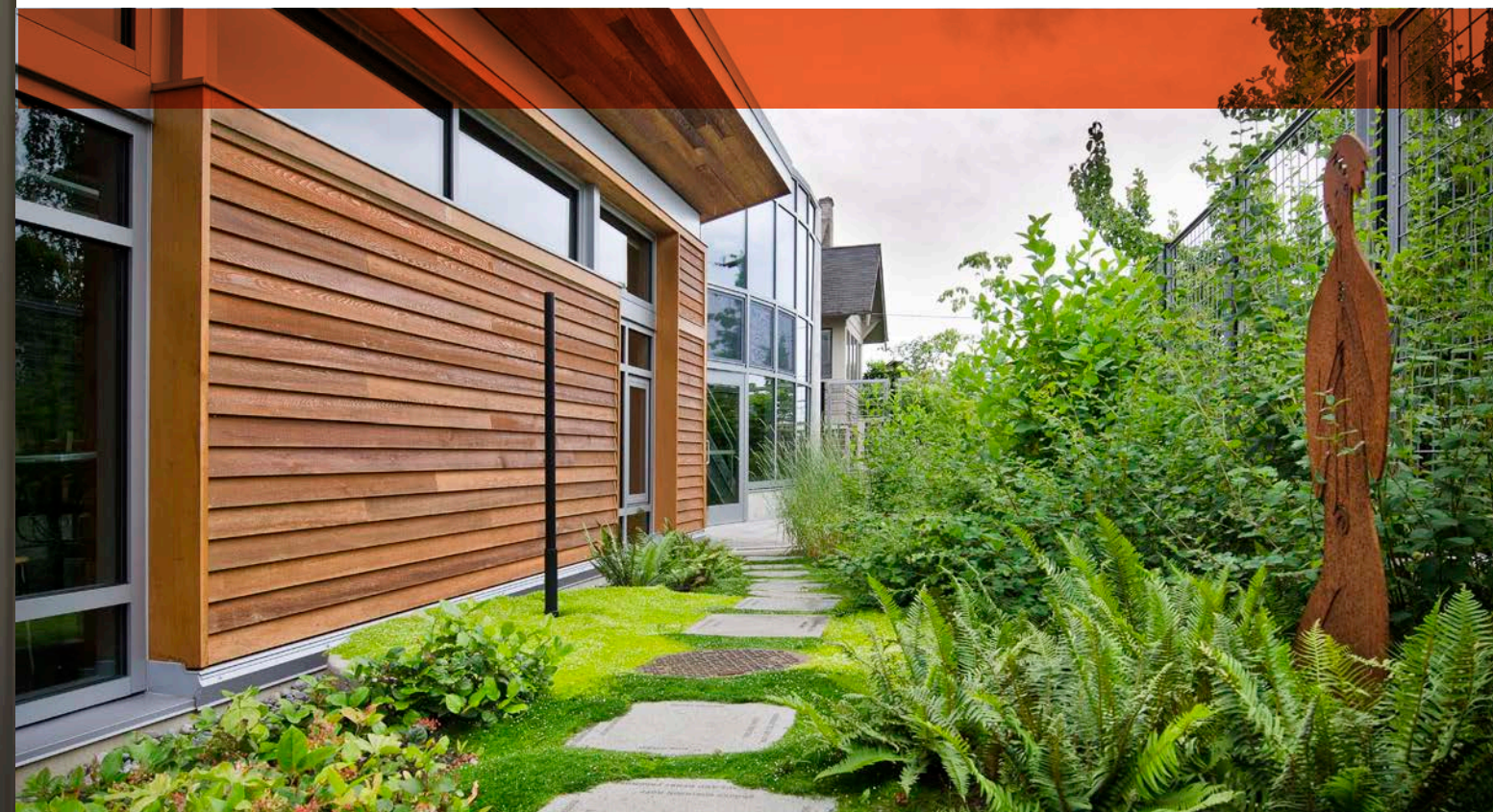
LEFT PHOTO:
RIGHT PHOTO: GGLO

INTEGRATED DESIGN PROCESS

Integrated design was truly necessary on this project. A team of consultants from across western Washington came together to donate all of their services for the design and much of the construction of this project. From the very first design charrette everyone from subcontractors to user groups to city officials were involved. Most importantly, this collaboration did not stop after the first meeting. These integrated team meetings continued throughout design and construction, which allowed all of us to investigate and implement the most sustainable solutions for the project. Having everyone involved during problem solving allowed us to quickly gain perspective from a variety of industry experts at once. This partnership brought out more creative and collaborative solutions for the duration of the project. A team that is truly invested at every level of the process is beneficial to the Owner, the individual team members and the environment. A Living Building requires true collaboration.

STUDENT INSPIRATION

When we began the project, we knew it was important to start with students. So we worked with Bertschi's Science Specialist, Julie Blystad, to talk with the students about what their idea for a Living Building science classroom should be. They created an inspirational wish list of items that, to them, embodied nature in a building. For us, it served as an inspiring theme we carried throughout the project. Inspiration became the catalyst for every aspect of this project from the very first idea of creating a case study Living Building. This student-generated wish list served as the starting point for the design of many of the key sustainable strategies and systems for the building. Using this list, we made their dreams into functional methods to solve the Challenge. The student's idea for a 'river in the classroom' became the glass covered runnel that carries rain water from the building roofs to the cisterns. Their 'room where something is always growing' became the living wall of plants that treats the building's grey water. One student even asked for a bamboo fountain where she could go to relieve her stress and this became the terminus art piece for the runnel.





“It really lets us connect with the environment. It also plays a large role in teaching us how to take care of the environment. I now compost at my house.”



LEFT PHOTO: BENJAMIN BENSCHNEIDER
RIGHT PHOTOS:

RECLAIMING THE SITE

The site where the Living Building Science Wing now stands was once an asphalt-covered play court. Not only did this present a site that supported storm water runoff and introduced an unnatural surface, it did not promote nature. There was no natural water infiltration, no plant life growing, and no urban sanctuary. And while the site had been previously developed for generations, it not only needed an improvement, it needed a restorative improvement.

We quickly learned that every square foot of the site would be important to creating a functioning Living Building since so many of the Imperatives are directly or indirectly tied to the site. The Net Zero Water Imperative is particularly site dependent. Even in the mild maritime climate of the Pacific Northwest, the collection and storage of enough potable and irrigation water during the dry summer months with the ability to infiltrate excess water during the remaining wet months was the challenge. Pervious pavement, underground storage tanks, and rain gardens were the solution and through the landscape design these elements became part of the beauty of the site while providing biophilic elements.

When this site was a ball court, it was surrounded by a solid wood fence with high netting above, presenting a closed, unnatural face to the neighborhood. In its restoration, the site fence and netting have been replaced with an open grid planted with grape and kiwi vines. A stepping stone pathway winds through Scotch and Irish mosses taking students through the lush garden. The beautifully curved exterior runnel, lined with reclaimed pebbles, transports collected rain water to the cistern and distributes excess water to the rain garden during storm events. At the beginning of the runnel a steel grating has student artwork depicting kelp, sea urchins, and their keystone species, sea otters. At its terminus the runnel spills into a basin with a bamboo fountain that slowly fills and empties in a rhythmic pattern. All of the elements are in an intimate garden sanctuary where students delight in nature and are insulated from the busy street nearby.

URBAN AGRICULTURE

The Bertschi Science Wing is the first certified Living Building Challenge project under the 2.0 Standard. The new Urban Agriculture Imperative required providing an area equal to 30% of the project area to be dedicated to agriculture. This resulted in two garden spaces incorporating both traditional vegetables as well as native ethnobotanical plants, many of which



are also food sources. This was a learning opportunity for the design team and school, as well as for the International Living Future Institute since this project was the first to implement the urban agriculture Imperative. The garden has proven to increase the learning opportunities for students through spaces of quiet interaction and other natural elements while meeting the intent of the local food production requirement.

In addition to simply providing food, a portion of Bertschi's garden is ethnobotanical. Ethnobotany is the study of the relationship between people and plants and the garden serves both as a productive landscape and an educational tool. The garden adds a physical component to the school's existing curriculum on Northwest Native culture and history. The team chose plants once used by Northwest Native people for food, fiber, and medicine. These species are key components of pre-European 'productive landscapes' and provide lessons both in the variety of productive landscapes and the ingenuity of Native peoples. Students and oth-

ers can explore the ethnobotanical garden plants and their uses through an interactive web site accessible through plant markers accessed with Quick Reference or QR codes. A scan of the code on the plant's identification plaque shows the common and scientific names along with a web site link providing information about the plant's many uses and botanical data. There are also pictures of the plants in different seasons so the students can see their cycle. These tools of technology give students a greater understanding and appreciation for the local flora while getting them outside to connect to it.

Soon after planting, the gardens began to produce. Vines filled with grapes climb the fences, grasses stand tall; ferns and moss have filled in, and blueberries, snowberries and lingonberries are flourishing. Students harvest fruit and other materials for consumption and for art projects. Using the berries, students grind them into various color paints. With grasses

and sticks from the garden, the students fashion paint brushes to create natural art.

Additionally, the harvest from the vegetable garden has been utilized for meals in the after school and summer programs. This outdoor classroom enhances student learning across disciplines, integrating science, social studies, geography, math, and literature as the garden prompts students to consider their relationship with food and the natural environment.

OUTSIDE INSIDE

Inside, the Science Wing houses a rectilinear classroom space, a restroom, an entry vestibule, and the curved glass-walled, high-ceilinged Ecohouse or greenhouse space. The Ecohouse opens directly onto the outdoor teaching area and ethnobotanical garden. With this space, no matter the weather, students can meet to examine and grow plant samples and experience hands-on learning about botany and habitats. Teaching occurs in both the classroom and the Ecohouse and both

spaces have north facing windows that look out into the garden while providing generous daylight. However, these are no ordinary teaching spaces. Running through the floor of both rooms is the pebble lined and glass covered runnel that transports to the cisterns and outside. The spaces are light filled and with open circulation, the rooms function well together for an extended classroom space. As a science classroom for young learners the spaces hold plenty of intrigue and opportunities for exploration with multiple connections to nature.

EFFICIENT SYSTEM

On-site photovoltaic power from a ninety module array provides all the energy for the Bertschi project. The PV system utilizes efficient micro inverter technology and provides a way for students to monitor the exact details of each panel through a web interface. As a grid connected system, net zero status is achieved through a calculated balance for the year and no storage capacity is necessary. The first step in creating this

energy efficient, net zero building was to understand the building's power requirements. Through detailed analysis the design team was able to learn the science program power requirements as well as to help reduce the school's preconceived energy assumptions. With a net zero building energy efficiency was always a chief concern throughout design. A highly insulated building envelope was one of the first priorities to create a thermally efficient building that would require minimal heating. The envelope consists of a 2x12 wood framing system and thermally efficient, insulated glazing throughout, all atop a ten-inch insulated slab. The roof is a structurally insulated panel or SIP which provides great insulating properties. The selection of every piece of equipment went through a rigorous evaluation process to determine its affect on the building's energy use. A hydronic radiant floor system provides heat for the building while natural ventilation is used for cooling. From daylighting and controls that reduce electric lighting load, to the use of gravity for water collection, energy efficiency was considered throughout the project. To eliminate phantom loads, automated controls turn off most plug loads each night. The occupants are required to activate a switch each day to turn receptacles back on.

RAIN WATER HARVESTING

Through perhaps one of the most delightful features of the building, the Bertschi science wing operates on net zero water. Rainwater is captured from the building's roofs and also from a section of the roof of the adjacent church building. As water collects on the classroom's butterfly metal roof it cascades through rain leaders exposed inside the building. From there it flows into a rock-lined runnel, or river, in the classroom floor winding along near the students desks and into the potable water cistern under the slab. Once that cistern fills, water overflows back into the continuation of the runnel to be transported outside to the irrigation cistern and rain gardens. Entirely visible to the students, this process mimics the hydrologic cycle within the

classroom. Excess storm water is also managed entirely on site. The first infiltration method for storm water occurs when rain is absorbed by the two moss mat roofs. These are similar to a traditional green roof but much thinner as they are located in the shadow of the adjacent building, providing excellent growing conditions for moss. However, the majority of excess storm water that reaches the site flows into the rain garden to achieve 100% infiltration.

ON-SITE TREATMENT

The building possesses the ability to treat rainwater to potable standards using carbon filters and ultraviolet light. While this is not yet allowable by the Washington Department of Health, the school and team had the foresight to install the system to be used as a case study in hopes that it can help to change water regulations. We believe the importance of demonstrating energy efficient potable water treatment is an essential step in our efforts to conserve resources.

To truly be net zero water the classroom also treats all of the waste water it produces on site. Grey water is directed to a system of coarse filtration and holding tanks then on to final treatment performed by a living wall of five species of tropical plants; the very wall the students had wished for with 'something always growing.' Located in the Ecohouse, the 165 square foot wall of common tropical plants naturally uptake grey water for growth and treatment completely disposing of it through evapotranspiration. This closed loop process requires no grey water storage. Most importantly, with this system the students have a direct link to the natural process and understand how the water they use must be treated and conserved.

As one of the features that students have the most interest in, the composting toilet treats all black water. Using a vacuum flush unit, the waste is broken down and composted within two tanks. After six to twelve



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| 1 Church building rain leader to cistern, exposed for education | 5 Potable tank hand pump for water appreciation |
| 2 Rain leader from classroom butterfly roof | 6 Energy Recovery Ventilator (ductwork omitted for clarity) |
| 3 Glass-covered interior runnel transports rain water to potable cistern | 7 Operable curtain wall window for ventilation |
| 4 Potable water cistern | |

months the compost is then ready to be added to the non-edible plant beds around campus.

The students are able to interact with water at every level in the Living Building. Removable glass tiles covering the runnel allow for water testing. Students can remove the lids on the cisterns and monitor the level indicators as well as perform volume studies. They can see the green wall treat the water they have sent down the sinks and use the hand pump to retrieve water from the cisterns. Through hands-on interaction with water, we find that students gain an appreciation and understanding for its conservation. Throughout the project it was important that students have a direct relationship with both the power and water they use. As they turn on a light, they watch the energy increase on the meter. As they collect water in the cisterns the gauges let them know the amount. Bertschi student's choices are making a direct impact on the building and it is helping to improve the operations.

CHEMICAL AVOIDANCE

As a Living Building 2.0 project, the science wing complies with the stringent Materials Red List and Appropriate Sourcing requirements. The team exhaustively vetted all products through an intense research and data collecting process involving five full-time team members who spent countless hours working with manufacturers to understand the components of their products while advocating for transparency. In addition to chemical avoidance, each product had to meet strict sourcing requirements. All of this work averaged approximately eight hours of research per material. Although this process was time consuming and often difficult, a detailed database was generated outlining product and manufacturer information that can be translated to future design work whether buildings are pursuing the Challenge or not. Of course one of the greatest achievements with the Materials Petal from the Bertschi project and others is the awareness we

all have brought to the industry regarding human and environmental toxicants in building materials.

While it is important to perform materials research and advocate for greater transparency, as designers we can first strive to reduce the need for products when possible. We worked to make careful choices to reduce the number of finish materials and even some systems used throughout the building. The wood structure of the SIPS roof is left exposed as the finished ceiling and the slab-on-grade concrete floor remains the finished surface. We chose simple mechanical systems to reduce site disturbance, piping and wiring. And because conservation should have multiple purposes, all mechanical and plumbing systems are left uncovered to help efforts to reduce unnecessary materials while exposing the building's function to the Bertschi students.

STUDENT VOICE

An often forgotten metric of sustainable design, we distributed post occupancy surveys to Bertschi's fifth graders near the building's one-year anniversary. With these responses we worked to address any concerns or recommendations students have which helps empower them to know that their opinions matter in both the design of the space and in how well it functions. It is so heartening to see that the students are understanding the purpose of their building and connecting with it to inform their educational journey on so many levels.

The most important aspect of this building beyond the sustainable features is the students who use it. Making a space that is comfortable, engaging, inspiring and healthy is what will help support their education and in turn create lasting environmental stewardship.



“It helps
me learn how
to be kind
to the earth”

“Our classroom
has made me
more aware of
buildings that
aren't living.”

NATURAL EDUCATION ELEMENTS

Always keeping the students and their educational needs in mind, we worked to ensure that the project made use of every opportunity to educate and inspire. All building functions are labeled so students can easily track building operations. And while the Living Building serves as a science classroom, the importance of its mission is translated to curriculum that spans all disciplines across the campus. The students monitor energy and water consumption in math while the art students are painting with grasses and berries from the garden. Building art installations bring the five salmon species, native leaves, and beetles imprints to the children’s fingertips. A hand pump in the greenhouse space allows students to pump their own water, bringing awareness about the billions of people on the planet that do not have access to clean water through a faucet. With these features and so many more, the Bertschi science wing strives to be a place of beauty for those who learn with it.

CONCLUSION

With such daily, integrated exposure during early education, the students at Bertschi School will carry these sustainability concepts with them years after leaving their journey from pre-K through fifth grade. In addition, they bring these concepts home to their families and friends who may not attend Bertschi. Just as important, the building also serves as an example to the greater community. It shows that this type of extreme sustainability and regenerative architecture is possible now. While this project is only a single building, the legacy of the Living Building Science Wing is not only how it will care for the environment by reducing its impact on it, but also how the sustainable features serve as an inspiration for future facilities and future generations.

PROJECT TEAM

GEOTECHNICAL

GeoEngineers

CIVIL

2020 Engineering

LANDSCAPE

GGLO

STRUCTURAL

Quantum Consulting Engineers

ARCHITECTURAL

KMD Architects

PLUMBING, MECHANICAL & ELECTRICAL

Rushing

SPECIALTY CONSULTANTS

O’Brien & Company

CONTRACTOR

Skanska USA Building, Inc.

URBAN ECOLOGIST

Back to Nature Design, LLC

BUILDING ENVELOPE ENGINEER

Morrison Hershfield



Chris Hellstern M.Arch, LEED AP, CDT served as a designer, project manager and the construction contract administrator for the Bertschi Living Building. He now practices sustainable architecture at ZGF Architects in Seattle.



Stan Richardson is the Director of Campus Planning for Bertschi School and was the school’s project manager and owner’s representative for the Living Building Science Wing.