LIVING ARCHITECTURE MONITOR®

A GREEN ROOFS FOR HEALTHY CITIES PUBLICATION

VOLUME 18 / ISSUE 3 / FALL 2016

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14TH ANNUAL CITIESALIVE WASHINGTON, DC

NOVEMBER 1-4, 2016

RISING TO THE STORMWATER CHALLENGE

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VOLUME 18
ISSUE 3
FALL 2016

INSIDE

On the Cover: The cover photo is of the Bosch parking garage project in Stuttgart, Germany. It is the largest Solar Garden Roof in the world, producing 870,000 kW/h electricity annually – enough for 250 German households. It also holds 1 million gallons of stormwater and provides pedestrian and bicycle passage in a gentle arc across a highway to a fairground. Photo: Frank Herzog. www.aero-art.de provided by Jörg Breuning.

LIVING ARCHITECTURE MONITOR

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LIVING ARCHITECTURE MONITOR IS PUBLISHED FOUR TIMES PER YEAR IN PRINT AND DIGITAL BY GREEN ROOFS FOR HEALTHY CITIES (GREENROOFS.ORG)

PERFORMANCE: OUR GREATEST STRENGTH IS ALSO OUR GREATEST WEAKNESS

The greatest strength of living architecture - that it delivers a multiplicity of performance benefits - is also its greatest weakness. For more than 15 years, North American leaders in the green roof and wall industry have been working to define living architecture performance: to measure that performance; develop products that embody performance; and to identify best practices in design, installation and maintenance that apply to a variety of living architecture systems.

Accomplishing these tasks has not been easy, and our job is most certainly not complete. Yet, while significant progress has been made, the complexity surrounding 'performance' only appears to continue to increase, bringing with it new challenges and opportunities. For example, there is complexity in the sheer variety and scope in the number of products now on the market, and combinations thereof; complexity in the wide range of environments in which they are implemented from the Yukon to New Mexico; complexity associated with living systems and fluctuations in their performance, depending in part on the nature of the ongoing inputs to them. There is also complexity in the tools and methods we use to measure performance, with different methods measuring the same performance criteria sometimes producing different results. There is complexity associated with emerging benefits tied to systems integration and the emergence of biophilic theory and practice. Finally, it is very difficult if not downright impossible, to quantify many of the important performance characteristics, such as beauty, or butterflies or the benefits of establishing community in a building.

In this issue of the LAM, we look at performance through a variety of lenses.

We asked four award winning green roof and wall designers to share their perspectives on performance in our On the Roof With feature. We explore one promising aspect of system integration - between green roofs and solar photo-voltaics (PV). This has considerable promise to enhance the performance of both technologies, as described by Jörg Breuning, a pioneer for more than 20 years.

Health performance and green building is the subject of my interview with Gail Vittori, Co-Director, Center for Maximum Performance Building Systems, Hanley Award Winner (2015), and a leader who has changed the nature of green building design by integrating health considerations. Vittori shares with us some of her insights and the remarkable positive impacts of living architecture on human health at the Dell Children's Hospital in Austin, Texas.

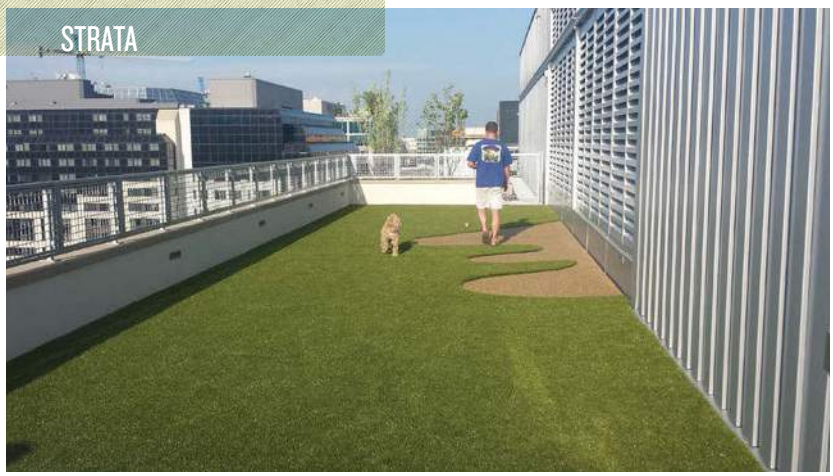
Water use performance in Green Walls is the subject of recent discussions we've had with a USGBC Technical Advisory Committee; and Melissa Daniels and Blaine Stand share GRHC's initial thoughts on this performance attribute and some of the complexities that make a one-size-fits-all prescription rather perverse.

At the leading edge of performance, we learn more about the production of electricity from green roofs in a piece on emerging technologies by Kara Orr.

We hope you enjoy the *CitiesAlive Program Guide*, embedded in this issue. We head to Washington, DC this November with our focus clearly on stormwater, a major policy driver for our industry. Our efforts to codify and standardize what we know about green roof performance; how it can be measured, accomplished and ranked are presented in an update on the Living Architecture Performance Tool (LAPT) program, which now lies with the Green Infrastructure Foundation. David Yocca, co-chair of the LAPT Committee makes a strong case for the ongoing development of the LAPT in the last LAM feature On Spec. The LAPT program carries the promise of cutting through much of the complexity and has the potential to revolutionize and build our industry upon an even more solid foundation of performance.

Sincerely yours,

Steven W. Peck,
GRP, Honorary ASLA
Editor

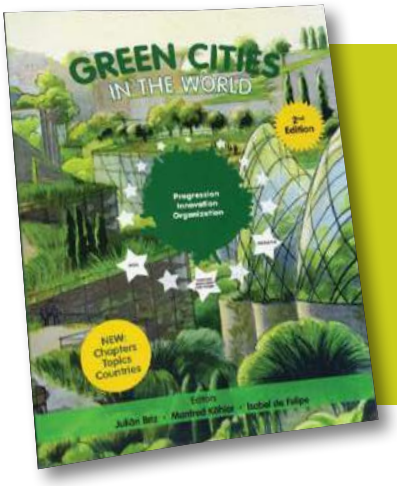


LIVING ARCHITECTURE
DOCTOR

The green roof is dead... what happened to it? Test your skills – tell us what went wrong on this green roof. Diagnose the problem by emailing editor@greenroofs.org. Your response could be featured in the next issue of the Living Architecture Monitor magazine.

SUMMER ISSUE
Extensive green roof with high level of aggregates and very thin substrate.

TREATMENT
It is likely that this particular vegetative mat was damaged during the installation or transportation process. It should be replaced. This very thin profile green roof in France was photographed by Steven Peck.

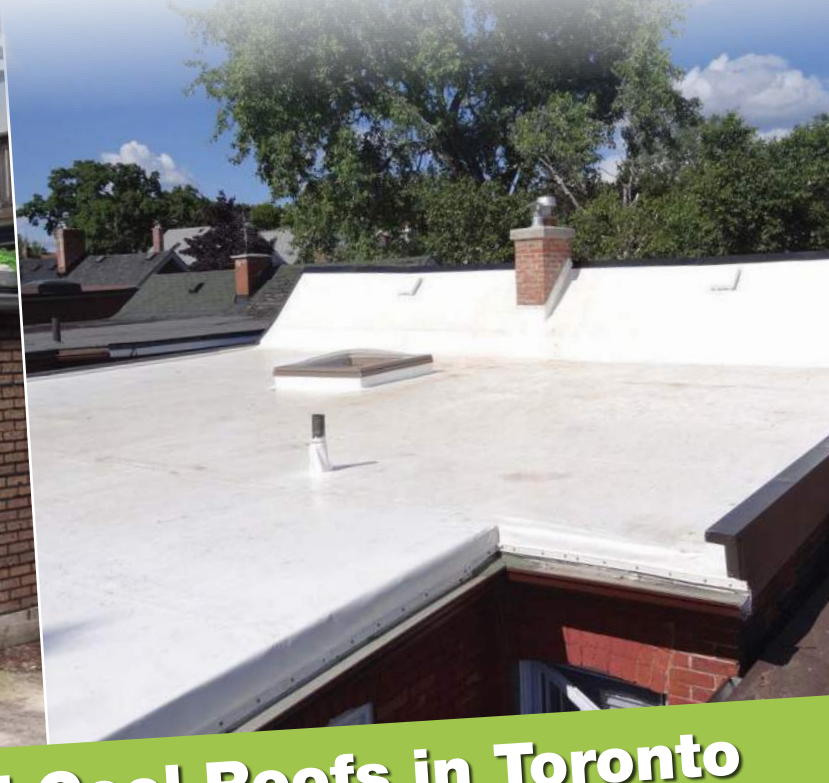


BOOK REVIEW: GREEN CITIES IN THE WORLD

This outstanding 2nd Edition contains fantastic color photos and a wealth of technical, design and policy knowledge about green infrastructure from more than thirty countries around the world. The book was compiled and published by the World Green Infrastructure Network, which is having its Congress in Bogota Columbia October 21-23. The book retails for US$59 plus shipping and handling. Contact editor@greenroofs.org to place an order.

eco roof INCENTIVE PROGRAM

Grants of up to $100,000 are available to support the installation of green and cool roofs in Toronto.



Grants for Green and Cool Roofs in Toronto

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Photo Courtesy of Molly Meyer.

ON THE ROOF WITH: PERFORMANCE TIPS AND PRIORITIES FROM AWARD WINNING GREEN ROOF DESIGNERS

Responses edited for length and clarity.

The LAM asked a number of straightforward questions regarding green roof performance to Molly Meyer, GRP, CEO, Omni-Ecosystems, Chicago, Ill; Barry Miller, ASLA, Savino & Miller Design Studio, Miami, FL; and Amy Falder and Chris Brunner, GRP, Partners, New York Green Roofs, Brooklyn, NY.

LAM: *How would you define performance in the context of green roofing?*

Molly Meyer (MM): Quantity, quality and diversity of ecosystem services – meaning an effective and well-performing green roof provides maximum ecosystem services (e.g. habitat creation, energy use and stormwater runoff reduction, urban heat island mitigation, etc.) for its context (e.g. weight capacity, site location, budget, etc.). Ultra-lightweight

THE EXPERTS

Barry Miller, RLA, ASLA, is a principal at Savino & Miller Design Studio, a Miami-based firm providing services in Landscape Architecture, Architecture, and Urban Design. The firm's diverse portfolio includes a range of award-winning projects in both the private and public sectors, with the goal of engaging the cultural and environmental context of the site with artistry, ecological sensitivity, and sustainable practices.

Amy Falder and Chris Brunner, GRP, are co-founders of New York Green Roofs – an award winning green roof firm based in New York City. Chris has been a leader in the implementation of urban landscapes since receiving his BA from Michigan State University in 2000. Amy earned her MS in Environmental and Plant Biology from Ohio University in 1999. Building on her extensive academic background in plant sciences Amy has spent the past 15 years thoughtfully pursuing horticultural work that positively impacts the lives of others in the New York area.

Molly Meyer, GRP, is the CEO of Omni Ecosystems and the Co-Founder of The Roof Crop. At Omni, Molly leads operations and business development for its living infrastructure solutions. At The Roof Crop, Molly manages farming operations for the rooftop farming company located in Chicago. Prior to founding Omni in 2009, Molly worked in the green roof industry in Germany as a Robert Bosch Fellow. She graduated from Stanford University, earning her B.S. with Honors and her M.S., both in Earth Systems.

meadow systems, categorized as "comprehensive green roofs", combining the best qualities of extensive green roofs (i.e. lightweight) and intensive green roofs (i.e. biodiversity, stormwater management, energy reduction), outperform sedum systems across these metrics.

Barry Miller (BM): That's often in the eye of the beholder, so to speak, and whether or not the roof is intended for the people to use. Personally, I would rate performance on factors such as 1) energy savings (HVAC), 2) stormwater management benefits, 3) savings in water resources, and 4) the extent to which it provides food and pollinating sources. Of course, if people can go up to enjoy it, all the better! As a Landscape Architect, we always hope to design green roofs that provide all of these benefits and approach each green roof design with the idea of "replacing" the landscape – and its requisite functions - that is lost at the ground level.

Amy Falder / Chris Brunner (AF / CB): It's got to meet the client's requirements and expectations, whomever the client may be. This could be purely aesthetic. It could be environmentally driven. It could even be economically driven, but if it isn't meeting the client's goals and expectations how well is it really performing?

LAM: *What do you think is the most important factor indetermining the long term performance of a green roof?*

BM: The first thought that comes to mind is how well it prevents leaking, and minimizes maintenance to

AND WITHOUT SITE SPECIFIC MAINTENANCE, THE BEST BUILT, BEST DESIGNED GREEN ROOF WITH THE HIGHEST QUALITY MATERIALS WILL EVENTUALLY FALL SHORT.

avoid this all-important issue. A leaking roof is a nightmare; the fear of leaks is the number ONE reason why clients shy away from green roof installation, along with initial costs. Almost as important is the measure of the green roof's ability to store and filter water, reducing impacts on stormwater collection systems while improving water quality. The first design "fundamental" in the design of green roofs and walls should be the required use of recycled water, whether by use of on-roof retention or from on-site cisterns.

AF / CB: We don't think you can separate quality design, quality material, quality construction, and an appropriate maintenance program as factors in determining long term performance. A good design, poorly executed, can be just as flawed as a bad design with great execution. And without site specific maintenance, the best built, best designed green roof with the highest quality materials will eventually fall short.

MM: Regular maintenance check-ups by a qualified and dedicated green roof technician are vital. Most green roof issues arise from a lack of routine oversight, and because people sometimes forget that green roofs are living systems. Identifying and resolving any concerns early are key elements to keep green roofs healthy.

LAM: *From a design perspective, what is most important to you in terms of green roof performance and why?*

BM: That depends on what your project goals are, and how the roof is intended to be used. If the roof is designed for people, the need to create a sense of beauty becomes more critical, as people will then be naturally attracted to the space. The measure of how much the user enjoys the space is most important then. If the purpose is to produce food or honey, then the roof design needs to respond to issues such as soil storage, composting, seasonal rotation of crops, and ease of maintenance. If all you need is a dense blanket of growing media and vegetation for purely pragmatic concerns of resource conservation, then the level of importance shifts to creating a reliable "cover", that requires minimal maintenance.

MM: A green roof must engage and satisfy its users. It should be visibly stunning, delighting people through a unique and visceral connection to nature. When the roof is not publicly accessible, it should be agriculturally productive, should provide habitat and respite to birds, butterflies and the many creatures that perform ecosystem services that we humans don't even comprehend, and should honor the Earth, providing more benefit to heal the planet than resources the space requires.

AF / CB: Chris says: Ecological performance. Amazing environmental design should be at the foundation of what we do as green roofers. Otherwise we're missing an opportunity to be a greater part of a needed solution. Amy says: Happiness. This might sound like a bunch of butterflies and unicorns, but the happiness of our clients, of people who get to see or walk on these projects, or of those who just hear of their existence shouldn't be ignored as a performance metric. Happiness matters.

ROOF COURTYARD, DELL'S CHILDREN'S HOSPITAL

Photo Courtesy of Steven Peck.

AN INTERVIEW WITH GREEN BUILDING PIONEER GAIL VITTORI

INTEGRATING HUMAN HEALTH INTO GREEN BUILDING AND THE DELL CHILDREN'S HOSPITAL

INTERVIEWED BY STEVEN W. PECK, GRP

From her porch at the Center for Maximum Potential Building Systems (CMPBS) bracketed by a large galvanized steel cistern on one side and lush green facades on the other, lies a view of a wide valley and the distant skyline of downtown Austin.

If 'keep it weird' is the slogan for Austin, then the CMPBS is the poster child of this place. The three acre campus is home to two solar decathlon winning houses, and innumerable green building technologies and experiments. Driven by a small dedicated staff, interns and the inexhaustible creativity of Gail Vittori and Pliny Fisk III, her lifelong partner, the CMPBS is something that must be experienced. Gail Vittori is co-director CMPBS, co-author *Sustainable Healthcare Architecture* and winner of 2015 Hanley Award for her many contributions and leadership in health and green building. I caught up with Gail to find out more about her work, her dreams and her passions earlier this year.

SWP: *Congratulations Gail! How did you feel when you were notified that you won this prestigious award? (She smiles and then chuckles.)*

GV: I would say a combination of being shocked, humbled and honoured, because I honestly didn't expect to win, particularly given the other extraordinary nominees.

SWP: *What do you think your most important accomplishments have been which lead to such recognition?*

GV: I understood that one of the recognized aspects of my work has been mentorship which has come about through the people I work with every day as interns, staff and volunteers and with the people I collaborate with on project teams and colleagues at the US Green Building Council. I also think that it would be my work on the strategic integration of human health in the practice of green building.

SWP: *Your work has led you to pioneer human health as a key component of green building. Can you tell us more about that?*

GV: I have had the benefit, in an odd way, of having come to the design profession without the formal training of a designer which enabled me to think differently about what should be a foundational pillar of design. It seemed to me that acknowledging the relationship between design and its impact on human

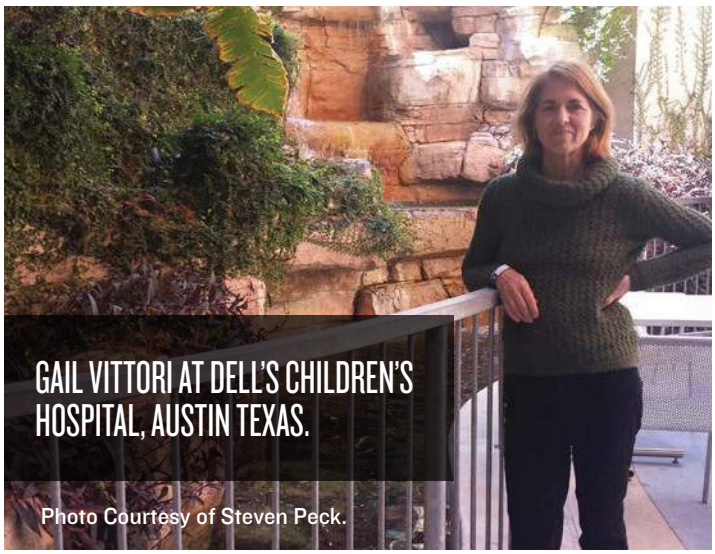
BY DESIGN, THE INTEGRATION OF NATURE PERMEATES THE EXPERIENCE, FROM BOTH INSIDE AND OUTSIDE THE HOSPITAL. THIS IS ACCOMPLISHED THROUGH SEVEN INTERIOR COURTYARDS, A 3.5 ACRE INTERACTIVE HEALING GARDEN FOR PATIENTS, PLANT SPECIES THAT REPRESENT THE DIVERSE ECOLOGICAL ZONES FROM WHICH THE YOUNG PATIENTS COME FROM AND ACCESS TO VIEWS OF NATURE FROM ALMOST EVERYWHERE WITHIN THE HOSPITAL.

health should be as foundational as any other consideration, if not more.

SWP: *Is there something that stands out for you in your work in this regard?*

GV: An unexpected focus of my work over the last 15 years has been working with the health care sector. This has provided the perfect context to gaining a clearer sense of the many dimensions of how the built environment impacts human health. Furthermore, the health care sector's mission is about health and healing. We need to understand that the root causes of our adverse health challenges can only be addressed by considering the larger context of the built environment. Hospitals are a great place to start, but we need to look at the broader environment, at materials, where and how we design, build and operate buildings in order to generate health promoting environments.

SWP: *You contributed to the design of the new Dell Children's Medi-*



GAIL VITTORI AT DELL'S CHILDREN'S HOSPITAL, AUSTIN TEXAS.

Photo Courtesy of Steven Peck.

cal Center of Central Texas which opened in 2007. It's the first LEED Platinum certified hospital in the world. How does living architecture like green roofs and walls contribute to the healthfulness of this extraordinary hospital?

GV: By design, the integration of nature permeates the experience, from both inside and outside the hospital. This is accomplished through seven interior courtyards, a 3.5 acre interactive healing garden for patients, plant species that represent the diverse ecological zones from which the young patients come from and access to views of nature from almost everywhere within the hospital. The conventional approach to larger hospitals is a large monolithic floor plate. What was achieved at Dell was to challenge this approach and achieve a healthier experience for staff, patients and visitors. We know that this makes a significant difference in terms of health recovery and staff performance.

SWP: *How do you know this?*

GV: Typical measures include patient length of stay, which is less than the norm; reduced use of medication; reduced staff turnover and enhance staff recruitment. These can save hospitals millions of dollars in human resource costs annually.

SWP: *One of the additional things you mentioned about Dell has to do with the performance of the cafeteria sales, being much greater than anticipated. Can you elaborate on that?*

GV: After the hospital had been operating for a period of time the hospital staff noticed much greater levels of cafeteria sales than other children's hospitals. They wondered why. The difference is that the cafeteria at Dell's opens is flanked on both sides on lush vegetated courtyards, one of which has an elaborate waterfall, which creates an inviting and compelling space for people who are facing stressful experiences. It is a remarkable place of respite, which features multiple biophilic elements, such as the sound of water, textured surfaces, dappled light, prospect and refuge. It is an environment that people fundamentally want to be in.

SWP: *What do you see as the greatest challenges to reorienting design with human well-being as the central focus?*

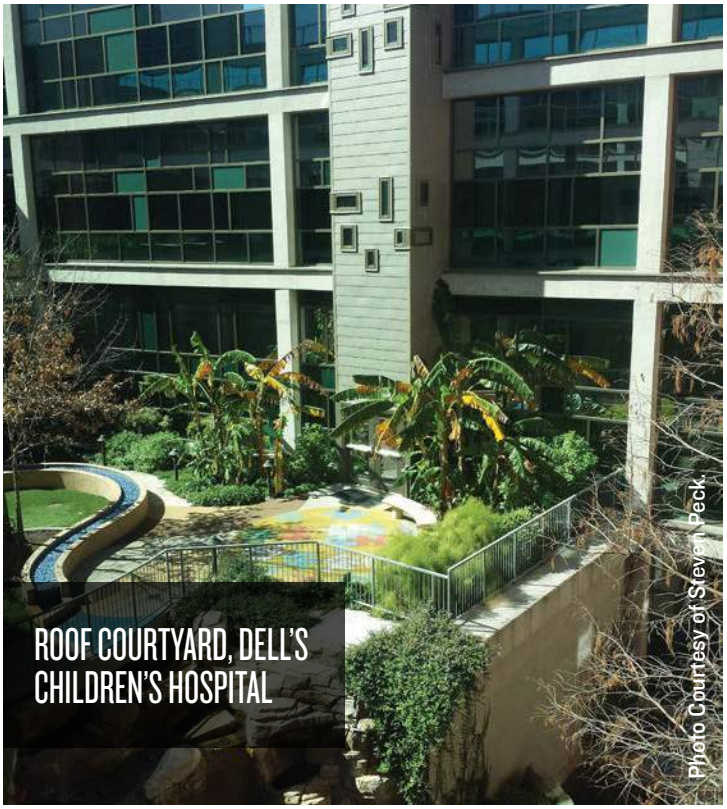
GV: The greatest challenge is people's concern about cost as the primary design consideration, and belief that to design different will cost more. The other challenge is complacency! What we are finding in terms of cost is that it is a mythology that a hospital like Dell cannot be designed within a traditional budget. We've done two studies with Perkins+Will on over 35 LEED certified hospitals in 2008 and 2012. The studies indicated that the capital cost premium was only 0 to 5 per cent, and in the 2012 study we found that for hospitals over 100,000 square feet the premium was only 0.67 per cent. These first costs premiums generated operational savings from water and energy, reduced staff turnover, improved recruitment and being a more competitive choice for attracting patients.

SWP: *What's on the horizon for Gail Vittori?*

GV: We just celebrated our 40th year of operation for the CMPBS so stay tuned!

FIND OUT MORE

Gail Vittori is a keynote speaker on Nov. 2, 2016 at the *14th Annual CitiesAlive Conference*, CitiesAlive.org. For more information on CMPBS visit www.cmpbs.org



ROOF COURTYARD, DELL'S CHILDREN'S HOSPITAL

Photo Courtesy of Steven Peck.

CASE STUDY: ECONOMIC PERFORMANCE BENEFITS FROM POST-OCCUPANCY ANALYSIS OF DELL CHILDREN'S HOSPITAL, AUSTIN

- Employee engagement increased by 5%
- Health and well-being of employees increased by 5%
- Frequency of undesirable health outcomes decreased by 4%
- Reduction in staff turnover rate – 3.57% less than national average saving $2.17 million in HR costs per year.
- Reduction of injuries and illnesses among staff by 7% vs. original hospital savings $4.5 million per year.

Source: "Return on Investment of LEED Platinum Hospital", Harris, D., 2014.

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PERFORMANCE AND EDGING RESTRAINT SYSTEMS

WRITTEN BY BLAINE STAND

Photo of Nationals Park, Washington, DC, courtesy of Permaloc

Edging restraint systems are an often overlooked aspect of green roof design and installation that can have important impacts on green roof performance over a project's life. We asked two edging experts, Aymie Clayton of Oly-Ola Edgings, Inc. and Daniel Martin, LEED AP of Permaloc, for their thoughts on what edging does and how it can impact green roof performance.

LAM: *Why are edging/restraint systems important?*

Aymie Clayton (AC): Edging restraint systems serve a number of important functions on landscaped green roofs. Specially engineered for use in green roof applications, green roof edging is used to separate plant material from hardscapes. It retains and separates green roof planting materials, as well as stones, pavers and tiles for rooftop walkways from hardscape and other materials. The edging creates a clear, well-defined edge, helps to maintain a clean edge and keeps material separated or in place. In addition, green roof edging with an "L"-shaped profile design and slotted wall construction, allows for effective water runoff. In addition, when edging products are lightweight, durable and made from 100% recycled post-consumer material, their use on a green roof can contribute to USGBC's LEED Rating System points.

Daniel Martin (DM): Edging and restraint systems are the backbone of green roof systems. They keep all of the components lined up and in place. Without proper edging, a green roof will quickly deteriorate with soil erosion or components shifting and moving, causing the structural integrity of the project to weaken. Edging prevents the movement of ballast and other items which could wear the membrane down or present safety hazards. Additionally, when a

quality edging is used, the crisp lines of a green roof design are held strong, and the visual appeal to the human eye remains intact. A low quality edging, or an edging made of improper material, will begin to curve or warp over time, causing the lines to look disjointed.

LAM: *How do edging/restraint systems affect green roof performance?*

AC: A specially-designed green roof edge restraint gives a landscape designer the opportunity to create beautiful roof gardens with truly appealing landscaping and alluring design concepts. The edging defines and separates planting materials, stones and pavers in green roof and living roof construction projects and allows a designer to create roof gardens designed to suit the specific needs of the users.

DM: Edging is vital to the long-term structural integrity of a rooftop. When everything is securely held in place the roof will last longer, while requiring less maintenance. By preventing growing media erosion, media depths remain as intended and plants have the necessary depth and nutrients to thrive. By keeping components in place, edging allows the membrane to last longer without being worn by abrasion. If an edging material absorbs heat, such as a dark plastic material, it could cause plants in close proximity to it to die off.

LAM: *What are some important features of good edging systems?*

AC: The most important feature of a quality green roof edging system is that the edging be constructed of a heavy-duty 100% recycled material. Black rigid polyvinyl chloride (PVC); carbon black concentrate; and impact modifier green roof edging will help to achieve LEED points and is available in flexible or rigid styles to suit the design. PVC edging is easy to install and does not require cutting or snipping to make curves. Also important are interior vertical wall 1.375" drainage slots that can effectively manage water runoff.

DM: Systems must be lightweight to lessen structural loads and able to withstand extreme temperature variations without damaging, as well as allowing for the free flow of water to avoid trapped water on the membrane. On many green roofs, aesthetics become important, as the edging can be visible to users of the rooftop space, so edging that offers aesthetic details work best in these scenarios. Finally, it is important that any edging resting on the membrane does not have edges that might puncture it, which is easily achieved by using edging that is specifically engineered for rooftop use, instead of simply fabricating bent sheet metal.

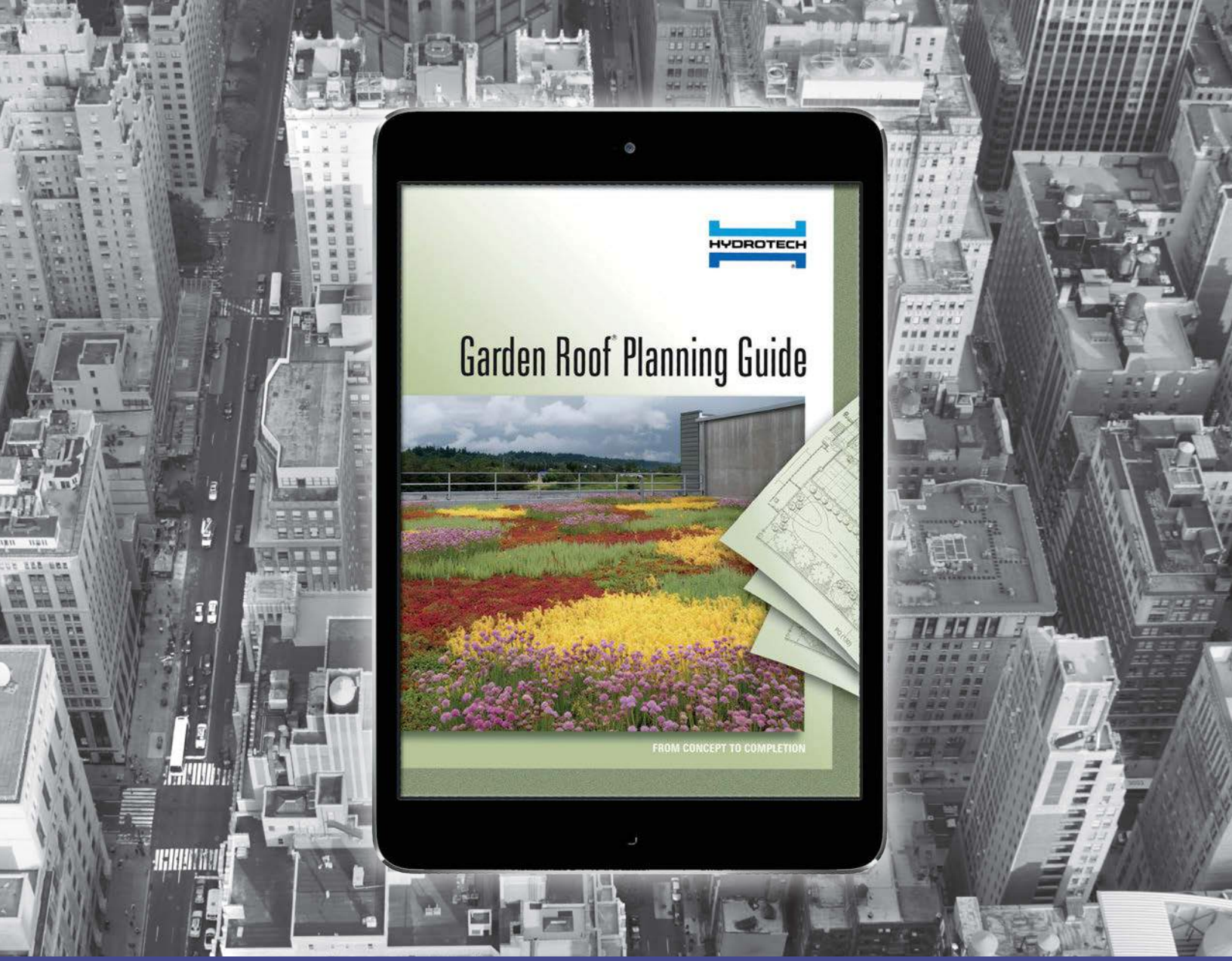
LAM: *What recommendations do you have for designers when choosing edging/restraint systems?*

AC: Talk to an edging specialist and explain your specific design needs. Ask the edging manufacturer to send you samples so that you can check out the durability, flexibility and/or rigidness of the edging product's construction. Think outside the box. Don't go with an edging product you've always used. Try something different. You just may really like the results. Also make sure that the manufacturer backs their product with a guarantee. The edging should be guaranteed to last 20 years or the lifetime of your project

DM: Choose edging that does not limit your design process. So many green roofs are a series of rectilinear lines, yet the majority of ground landscapes are curvilinear. Edging products should match your design instead of limiting it, so work with a company that has expertise in edging and is able to offer solutions. Many times edging is the last thing considered, and often the first thing compromised when budget considerations arise. It's important to remember that your design is created by a series of lines, and they are important to maintain for a project to look as good in its tenth year as it does on its first day.

Blaine Stand is the Membership Coordinator at Green Roofs for Healthy Cities.

Photo courtesy of Oly-Ola.



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WASHINGTON DC: NOVEMBER 1-4, 2016

A GREEN ROOFS FOR HEALTHY CITIES EVENT

RISING TO THE STORMWATER CHALLENGE

CONFERENCE GUIDE

Join green roof and wall industry leaders this November in North America's foremost city for green roof policy and implementation – Washington, DC – for the *14th Annual CitiesAlive Green Roof and Wall Conference*. Since *CitiesAlive* was last in Washington, DC in 2005, the green roof market in the nation's capital has exploded. For five years in a row, Washington, DC has led North America in green roof installation, and is on the forefront of supportive and innovative policy development.

This year's conference will highlight advancements in living architecture design, research and policy, with a focus on stormwater management. Explore the science behind green roof and wall performance and learn how these technologies are enabling designers to meet municipal stormwater management requirements.

Discover new products and services at the *CitiesAlive* trade show, tour some of DC's best green infrastructure projects, and enhance your professional practice with continuing education and networking events. *CitiesAlive* kicks-off with a *Stormwater Technical Workshop*, a full-day expert-led workshop covering the functions of different green roof layers in managing stormwater, existing standards, a review of current regulations, cost-benefit information and more.

Photo courtesy of the University of the District of Columbia

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REGISTRATION RATES

Package	What's Included	Member	Non-Member
Stormwater Engineering Package	Stormwater Technical Workshop, All Technical Sessions & Keynote Speakers, Trade Show, Hospitality (Opening Reception, Coffee Breaks, Lunch on Trade Show Floor), Conference Recordings - Total Value $1,258. *Pending approval for 17 Continuing Education Credits.* **Note that this package does not include the Awards of Excellence Luncheon*	***$799*** until Sep 15 ***$889*** Sep 15 - Oct 14 ***$919*** starting Oct 15	***$959*** until Sep 15 ***$1,049*** Sep 15 - Oct 14 ***$1,079*** starting Oct 15
Best Price Delegate Pass	All Technical Sessions & Keynote Speakers, Trade Show, Hospitality (Opening Reception, Coffee Breaks, Lunch on Trade Show Floor & Awards of Excellence Luncheon), Conference Recordings -Total Value $998. *Pending approval for 11 Continuing Education Credits.*	***$729*** until Sep 15 ***$759*** starting Sep 16	***$889*** until Sep 15 ***$919*** starting Sep 16
Delegate Pass	All Technical Sessions & Keynote Speakers, Trade Show, Hospitality (Opening Reception, Coffee Breaks, Lunch on Trade Show Floor & Awards of Excellence Luncheon) - Total Value $819. *Pending approval for 11 Continuing Education Credits.*	***$629*** until Sep 15 ***$659*** starting Sep 16	***$789*** until Sep 15 ***$819*** starting Sep 16
Stormwater Technical Workshop	November 1st Technical Sessions, Lunch, Access to the Trade Show, the Opening Plenary Reception, and the Keynote Presentation of CitiesAlive. ASCE Members Receive $50 Off. *Does not include any programming on November 2, 3, or 4. Pending approval for 6 Continuing Education Credits.*	***$299***	***$349***
For more registration options, visit CitiesAlive.org			

NOVEMBER I: STORMWATER TECHNICAL WORKSHOP

The first-ever **Stormwater Technical Workshop** is designed to provide civil engineers, designers, building owners and policy makers with a solid technical grounding in how green roofs are able to effectively and economically manage stormwater.

Join industry experts from business and academia as they present the science, engineering and standards associated with various green roof assemblies emphasizing how these systems can be designed to maximize stormwater retention.

The workshop includes technical sessions, access to expert trade show exhibitors, a gourmet lunch on the *CitiesAlive* trade show floor, and the *CitiesAlive* cocktail reception and opening plenary with **George Hawkins, Esq, CEO & GM, DC Water**. Mr. Hawkins will discuss DC Water's exciting new green infrastructure plans, operating the world's largest advanced water treatment plant, and more!

9:30 - 9:45 am	**INTRODUCTORY SESSION** Steven W. Peck, GRP, Hon. ASLA, Green Roofs for Healthy Cities
9:45 am - 12:00 pm	**SESSION 1: TECHNICAL INFORMATION ON GREEN ROOFS AND STORMWATER** **Session 1a: Introduction to Green Roof Systems and Standards** *Scott McGaughy, Greenrise Technologies* **Session 1b: Green Roof Media – What It Does** *Angie Durhman, GRP, AD Greenroof LLC; Joshua Robinson, P.Eng, Robinson Design Engineers* **Session 1c: Drainage Layers/Materials** *Gaelle Wormus, GRP, Vegetal i.D.* **Session 1d: Water Retention Strategies/Products/Capillary Layers** *Richard Hayden, GRP, RLA ,ASLA, CLARB, American Hydrotech Inc.* **Session 1e: The Role of Vegetation** *Brad Rowe, Ph.D., Michigan State University*
12:00 - 2:00 pm	**TRADE SHOW OPENS** (Gourmet lunch on the Trade Show floor)
1:30 - 3:00 pm	**SESSION 2: POLICY DRIVERS** **Session 2a: Regional Stormwater Requirements in DC** *Hamid Karimi, District of Columbia Department of Energy & Environment* **Session 2b: Overview of Regional Requirements - Baltimore, Montgomery County, Philadelphia, New Jersey, New York** *Blaine Stand, Green Roofs for Healthy Cities* **Session 2c: General Services Administration Green Roof Requirements (1.7 inches)** *Lance Davis, AIA, LEED AP BD+C, U.S. General Services Administration*
3:15 - 4:30 pm	**SESSION 3: THE BUSINESS CASE** **Session 3a: Business Case – How and When Green Roofs Can Outperform Other BMPs** *Rick Scaffidi, Environmental Quality Resources LLC; Mary Travaglini, Montgomery County Stormwater Facility Inspection and Maintenance* **Session 3b: Other Bottom Line Benefits for Developers** *Vanessa Hostick, Sustainability Specialist, HOK Washington, DC*
4:30 - 5:00 pm	**SESSION 4: CLOSING SESSION – Expert Panel Q & A** *Oscar Warmerdam, Sempergreen; Matt Barmore, Greenrise Technologies*
5:00 - 6:45 pm	**HOSPITALITY ON THE TRADE SHOW FLOOR**
6:45 - 7:45 pm	**CITIESALIVE OPENING PLENARY & KEYNOTE** *George Hawkins, Esq, CEO & GM, DC Water* *Jeffrey L. Bruce, GRP, FASLA, Jeffrey L. Bruce & Company; Green Roofs for Healthy Cities* *Steven W. Peck, GRP, Hon. ASLA, Green Roofs for Healthy Cities*

CONFERENCE HOTEL

Omni Shoreham Hotel

2500 Calvert St NW, Washington, DC 20008
1-800-843-6664

Stay at the conference hotel, and you'll be in close proximity to the conference venue and Capitol View at 400 reception, all on the DC Metro's Red Line. *CitiesAlive* attendees receive reduced room rates of $229-$269 per night for reservations made prior to October 12th. Book your room at **CitiesAlive.org**. If booking by phone, please indicate you are attending *CitiesAlive* to receive the conference rate.

Photo courtesy of the Omni Shoreham Hotel

NOVEMBER 2

8:30 am - 10:15 am	**Morning Plenary and Keynotes** Welcome & Introduction - *Sara Loveland, Chair, Green Infrastructure Foundation, Partner, Annette Environmental Inc.* Welcome to Washington, DC - *Muriel Bowser, Mayor of Washington, DC (Invited)* Green Roofs, Urban Food Production, and Job Creation: the UDC Urban Food Hubs Solution - *Sabine O'Hara, University of the District of Columbia* Innovative Stormwater Management for DC - *Tommy Wells, Department of Energy & Environment* Integrating Biophilic Design into Green Building: the Human Health Benefits - *Gail Vittori, Center for Maximum Potential Building Systems*		
10:30 am - 12:00 pm	**Technical Session 1**		
Latest Advancements in Green Stormwater Management Technology	**Evaluating Stormwater Retention Benefits of Green Roofs**	**Stormwater Best Management Practices Considerations: Economics, Cost Comparisons and Engineering Permitting Requirements**	**Green Walls & Water Management; Stormwater Management & Potable Water Use Best Practices**
Rooftop Stormwater Retention: Hybrid Systems and Smart Blue Roof Technology *Anthony Mayer, Hanging Gardens;* *Mary Ostafi, Urban Harvest STL*	Stormwater Retention of an Integrated Stormwater Management System on a Sustainable Home *Rhea Thompson, University of Maryland*	The Economics of Best Management Practices for Stormwater Retention *Stéphane Larocque, Impact Infrastructure*	Session Chair: *Warren Gorowitz, Ewing Irrigation and Landscape Supply* Panelists: *Dr. Alan Darlington, Nedlaw Living Walls* *Hal Thorne, GSky Plant Systems Inc.* *Melissa Daniels, Plant Connection Inc.*
Blue+Green: Combining Open-Water and Soil/Vegetation Systems to Manage Stormwater Runoff *Charlie Miller, P.E., Roofmeadow*	Monitoring of An Intensive Vegetated Roof in St. Paul MN *Angie Durhman, GRP, AD Greenroof LLC*	Green Infrastructure Construction Cost Comparisons *Katrina Emery, Environmental Quality Resources, LLC; Rick Scaffidi, Environmental Quality Resources, LLC*	
Expanding Effectiveness of Green Solutions Through Smart Controls *Kevin C. Dutt, RainBank Inc.;* *Micah Shapiro, Urban EcoForms*	Urban Rooftop Agriculture meets Low Impact Development (LID) *Michael Sánchez,Washington State University*	The Intersection of Living Roof Stormwater Management Research and Engineering Permitting Requirements *Dr. Elizabeth Fassman-Beck, Stevens Institute of Technology*	
2:00 pm - 3:30 pm	**Technical Session 2**		
Green Stormwater Management Case Studies From Around the World	**How to Influence the Stormwater Retention of Green Roofs**	**Landscape Performance to Demonstrate Impact: Three DC Case Studies Performance Evaluation**	**New Models of Financing: Green Infrastructure through Stormwater Fees & Credits**
Designing for Biodiversity Green Roofs in Europe *Kamilla Aggerlund, Landscape Architect MDL, University of Copenhagen*	Promote Green Roof Stormwater Performance with Mineral Wool Layer *Dr. Darja Majkovic, Knauf Insulation d.o.o.*	This session highlights three high-performing green roof case studies in Washington, DC while exploring the concept of landscape performance, introducing online tools, and presenting widely-applicable metrics and methods to measure environmental, social, and economic impact. *Barbara Deutsch, FASLA, Landscape Architecture Foundation;* *Dr. Christopher D. Ellis, PLA, ASLA, University of Maryland;* *Dr. Victoria Chanse, University of Maryland*	Session Chair: *Matt Barmore, Greenrise Technologies* Panelists: *Kahlil Kettering, The Nature Conservancy Maryland/DC Chapter* *Adam Ortiz, Prince George's County* *Doug Siglin, Anacostia Waterfront Trust* *Jane Silfen, Encourage Capitol* *Daniel T. Nees, Environmental Finance Center, University of Maryland* *Brian Van Wye, District Department of Energy & Environment*
Using Green Wall Evapotranspiration to Manage Storm Discharge: An Example in San Juan, Puerto Rico *David L Aponte Dones, GRP, MSCE, Office of Landscape Architecture*	Quantify Drainage Layer Effects on Living Roof Peak Flow Mitigation *Lei Lei, Stevens Institute of Technology*		
2016 Top 10 List of Hot Trends in Greenroof & Greenwall Design *Linda Velazquez, GRP, ASLA, LEED AP, Greenroofs.com; Haven Kiers, GRP, ASLA, LEED AP, Greenroofs.com*	Nutrient Dynamics Challenges and Solutions in Runoff from Green Roofs *Mark E. Mitchell, University of Cincinnati; Dr. Ishi Buffam, University of Cincinnati*		
2:00 pm - 3:30 pm	**Technical Session 3**		
Overcoming Site Specific Constraints	**Green Infrastructure Benefits & Policy Implementation Research**	**Design for Stormwater Resiliency: Case Studies of Green Infrastructure Projects**	**Identifying Priority Research Needs for Green Roofs and Green Walls**
Seven Year Retrospective on Cold Climate Exterior Living Wall *Sue Sirrs, Outside! Planning & Design Studio; Tim Amos, Nova Scotia Community College*	Acoustical Properties of Living Wall Plants and Systems and Modeling of Room Acoustic Benefits *Dr. Maureen Connelly, British Columbia Institute of Technology*	Green Roofs as Resilient Water Management Solutions: Two Case Studies in Portland Oregon *Andrea Saven, ASLA, LEED AP, Columbia Green Technologies*	Session Chair: *Kevin Kampschroer, U.S. General Services Administration* Panelists: *Lynda Wightman, Hunter Industries* *Paul Kephart, ASLA, Rana Creek Living Architecture* *Virginia Russell, GRP, FASLA, University of Cincinnati* *Dr. Youbin Zheng, University of Guelph* *Dr. Reid Coffman, Kent State University*
An Undiscovered Resource: The Case of UDC Green Roof Project *David Bell, AIA, LEED ap BD+C, BELL Architects; Sandra Farber Bandier, University of the District of Columbia; Oliver Boehm, RLA, ASLA, LEED-AP, ENV-SP, Volkert, Inc*	A Blueprint for a Green Roof Policy: Managing Melbourne's Stormwater with Green Roofs *Joseph Glesta, University of Melbourne; Victorian Government*	Critical BMP in a Green Infrastructure System: Cost and Performance Data for a Buffalo, NY Project *Gaelle Berges Wormus, GRP, Vegetal i.D.*	
	Perceived Barriers to Green Roof Adoption Among Michigan Consumers *Joanne M. Westphal, Michigan State University*	DC's First Elevated Park: 11th Street Bridge Park *Hallie Boyce, RLA, ASLA, OLIN; Jason Long, OMA*	

**Please note that the agenda is subject to change without notice.*

NOVEMBER 3

8:30 am - 10:30 am	**Technical Session 4**		
Design Considerations for Stormwater Retention Projects: Growing Media, Green Infrastructure Integration & Wind Uplift	**Innovative Research on Green Roof Plants & Growing Media**	**Case Studies of Stormwater Management Policy Developments and Design**	**How Biophilic Design Heals: Human Health in Schools, Offices & Hospitals**
Growing Media Stormwater Mechanics in Laymen's Terms *Chuck Friedrich, GRP, RLA, Carolina Stalite Company*	The Case for Green Roof Maintenance Long-Term Sedum Performance, Green Roof Weeding & Thermal Performance *Dr. Bill Retzlaff, SIUe; Kayla Tatum, SIUe; Caleb Mau, SIUe*	Managing Stormwater Runoff in Urban Agriculture : A Case Study of Local Farms in Baltimore City *Meghan Boian, American Rivers* *Jennifer Hughes, American Rivers*	Session Chair: *Jeffrey L. Bruce, GRP, FASLA, Jeffrey L. Bruce & Company; Green Roofs for Healthy Cities* Panelists: *Catie Ryan, LEED AP BD+C, Terrapin Bright Green NYC* *Elizabeth Freeman Calabrese, AIA, NCARB, LEED AP, Calabrese Architect;* *Elizabeth Hart CDT, GRP, Tremco* *Gail Vittori, Center for Maximum Potential Building Systems*
Grantchester Meadows Redux: Integrating Water with Green Infrastructure *Randy Sharp, GRP, FCSLA, ASLA, LEED AP; Reuben Freed, greenscreen*		Greening Harlem: Report of the CitiesAlive 2015 Harlem, New York Legacy Project *Rohan Lilauwala, Green Roofs for Healthy Cities*	
Wind Uplift Design Practice and Standards *Richard Hayden, GRP, RLA , ASLA , CLARB, American Hydrotech, Inc.*	Use of Recycled Crushed Porcelain for Green Roof Substrates *Dr. Brad Rowe, Michigan State University; Jason Matlock, Michigan State University; Dr. Mert Eksi, Istanbul University*	Green Infrastructure & Environmental Justice: Vegetated Walls in South Seattle, Washington *Andrew Schiffer, Just Health Action; Alberto Rodriguez, Duwamish River Cleanup Coalition*	
	Smart Substrate Formulation for Stormwater Quality and Quantity Management *Tyson Jennette, University of Guelph* *Dr. Youbin Zheng, University of Guelph*	Green Roofs: Promoting Cities Sustainability in Madrid, Spain *Daniela Torres, Universidad Politécnica de Madrid; Juan Pablo Moreno, Universidad Politécnica de Madrid*	

10:45 am - 12:45 pm	**Technical Session 5**		
Designing Stormwater Runoff Minimizing Green Walls	**Latest Research Findings in Green Roofs Performance Measurements, Effects of Fertilizer in Water Quality and Product on Extensive Green Roofs**	**Innovative Stormwater Solutions**	**The Treatment Train - Integrated Design Practices for Stormwater Management**
Water, Indoor Plant Walls and Building Performance *Dr. Alan Darlington, Nedlaw Living Walls*	Monitoring Stormwater Runoff and GreenRoof Performance with Sensor Networks *Dr. John Lea-Cox, University of Maryland; Charlie Miller, P.E, Roof Meadow, Inc.; Dr. Ari Novy, United States Botanic Garden*	Green Infrastructure Solutions in the Urban Realm: A Case Study of Rhode Island College Parking Lot *Timothy Brown, GRP, RLA, Birchwood Design Group, LLC*	Session Chair *David Yocca, FASLA, AICP, LEEP AP, Conservation Design Forum* Panelists: *Jeremy Bailey, Green Blue Urban* *Bryan Seipp, Center for Watershed Protection* *Richard Hayden, GRP, RLA, ASLA, CLARB, American Hydrotech Inc.* *Bill Foley, GRP, CSI, CCPR, LEED GA, ZinCo USA*
Living Alternatives to Concrete Retaining Walls *Mark Woolbright, Filtrexx International*	Advancing Methodologies for Monitoring Green Roof Stormwater Performance *Gaelle Berges Wormus, GRP, Vegetal i.D.; Dr. Qian Liao, University of Wisconsin-Milwaukee*	Me 1st - Mother Earth 1st - Urban Street Design *Sean Surla, MLA, ASLA, Surla Renewable Landscape Design*	
Green Walls and Hanging Gardens *Matthew T. Berrelli, P.E., Ronstan Tensile Architecture*	Water Quality in Biosolids-Fertilized Green Roof Runoff *Dr. Kevin Gilmore, PE, Bucknell University*	Natural Play is Green at Great River School *Todd Shoemaker, Wenck Associates, Inc.; Lucius Jonett, Wenck Associates, Inc.*	
LED Lighting for Greenwalls *Nathan Weipert, Sunlite Science & Technology*	A Comparative Fertility Trial for Produce On An Extensive Green Roof *Richard A. Little, Southern Illinois University Carbondale; Karen Stoelzle Midden; Southern Illinois University Carbondale*	Building Stormwater Retrofit over Highway: Rainwater Capture and Remote Sensing at the US Tax Court *Darren Destefano, General Services Administration*	

1:00 pm - 2:45 pm	**Awards of Excellence Luncheon and Closing Plenary**

KEYNOTE SPEAKERS - NOVEMBER 2

TOMMY WELLS

Director, Department of Energy & Environment

Innovative Stormwater Management for DC

SABINE O'HARA

Dean & Director, Landgrant Programs, College of Agriculture, Urban Sustainability and Environmental Sciences, UDC

Green Roofs, Urban Food Production, and Job Creation: the UDC Urban Food Hubs

GAIL VITTORI

Co-Director, Center for Maximum Potential Building Systems

Integrating Biophilic Design into Green Building: the Human Health Benefit

TRAIN WITH EXPERTS IN THE GREEN ROOF AND WALL INDUSTRY

Green Roof Design and Installation

November 1, 8:30 am - 5:00 pm
Instructor: TBC
$475 members / $499 non-members

The first of three full-day courses in the Green Roof Professional training program, Green Roof Design and Installation presents indispensible information for designers and practitioners, including: essential qualifications for project teams; budget development considerations; strategies for integrating green roofs with other building systems for maximum client benefit; implementation issues for new and retrofit buildings; contracts and construction administration; and quality assurance, warranty and liability issues. Explore the latest technical standards and research developments and learn how to meet green roof project objectives on schedule, to specification, and within budget.

Introduction to Rooftop Urban Agriculture

November 1, 8:30 am - 12:00 pm
Instructor: Ben Flanner, President & Director of Agriculture, Brooklyn Grange
$175 members / $199 non-members

Building-integrated agriculture is rapidly evolvin, and recent technological innovations are enabling urban farmers to use once underutilized spaces for food production. This course discusses practical applications of green roof and wall technologies that can be used to implement productive rooftop farming initiatives. Case studies describe pioneering urban farm operations and reveal key factors for project success.

Advanced Green Roof Maintenance

November 1, 1:00 - 5:00 pm
Instructor: Andy Creath, Owner, Green Roofs of Colorado, LLC
$175 members / $199 non-members

Whether you're a green roof designer, consultant, installer, owner, or caretaker, planning and budgeting for maintenance is critical to the long-term success of your projects. This course examines green roof maintenance best practices, and approaches for rehabilitating neglected green roofs. Learn how to develop maintenance plans, contracts, and inspection reports that work in concert with warranty requirements.

Green Walls IOI: Systems Overview and Design

November 1, 1:00 - 5:00 pm
Instructor: Melissa Daniels, CNLP, Vice President & Horticultural Specialist, Plant Connection, Inc.
$175 members / $199 non-members

This course discusses design and construction best practices for green facades and living walls, including maintenance and irrigation requirements. Discover the latest research findings on the environmental benefits of these technologies.

Making it Work: How to Properly Construct Low Impact Development Green Infrastructure

November 4, 8:30 am - 4:30 pm
Instructor: Kyle Vander Linden, Water Resources Specialist, Credit Valley Conservation, Credit Valley Conservation
$349 members / $399 non-members

Low Impact Development (LID), is an innovative stormwater management approach that treats, infiltrates, filters, and retains runoff at the source. This course is applicable to anyone involved in the design, construction, and inspection of LID, whether it is in a large subdivision development or a small parking lot retrofit. Participants will be taken through each step of the LID construction highlighting potential errors and explaining proper techniques. You will also receive recommendations for specifications and tender contracts. The experienced instructors will present valuable lessons learned from recent projects.

All courses include detailed reference manuals. Courses are eligible for one Continuing Education/Professional Development Credit per hour of learning from LA CES, AIA CES, USGBC/GBCI, APLD, NALP/CNLA, and more. Full day courses include lunch.

SPECIAL EVENTS

Halloween Networking Event

October 31, 8:00 - 10:00 pm
Price: Free for GRPs / $15 members / $25 non-members

Don't miss the opportunity to meet fellow *CitiesAlive* attendees before the conference starts. On October 31st, join GRHC members and like-minded green infrastructure professionals for the *CitiesAlive* Halloween Networking Event at the Omni Shoreham Hotel. Expect the evening to be full of fun with colleagues from across the globe.

GRP Business Skills Development Session (GRPs ONLY)

November 1, 5:00 - 6:30pm
Price: Free for GRPs

Exclusive for GRPs, join us for the *Fundamentals of Green Roof Design, Installation and Maintenance* CEU presentation & GreenSave Life Cycle Cost-Benefit Calculator tutorial.

Capitol View at 400

November 2, 7:30 - 10:30 pm
Price: $49

Connect with colleagues and develop your network at the Local Host Committtee Reception at Capitol View at 400, Washington, DC's premier rooftop venue. The spectacular view spans 300 degrees and includes landmarks like the Capitol and the Washington Monument. Your entry includes two drink tickets, as well as hors d'oeuvres, a light dinner buffet and desserts sourced from Main Event Caterers, an award-winning company known for their sustainable sourcing and operations.


Photo courtesy of Capitol View at 400

EXCLUSIVE TOURS - NOVEMBER 3 & 4

UDC SUSTAINABILITY TOUR

November 3, 3:00 - 4:30 pm / $29

Explore innovative green infrastructure and sustainability features at UDC's Van Ness campus.

AMERICAN UNIVERSITY TOUR

November 3, 3:00 - 5:00 pm / $29

Join American University's sustainability team for an exclusive visit to some of the numerous green roofs on the AU campus.

US TAX COURT PLAZA TOUR

November 4, 9:00 - 11:00 am / $29

Discover how stormwater collected from nearby impervious surfaces and CO_2 from traffic sustains this unique green roof.

CANAL PARK TOUR

November 4, 9:00 - 11:00 am / $29

Built on a former brownfield, Canal Park incorporates an extensive stormwater collection and reuse system, including rain gardens, LID tree pits, green roofs and 80,000 gallons of underground cistern capacity.

CITYCENTERDC TOUR

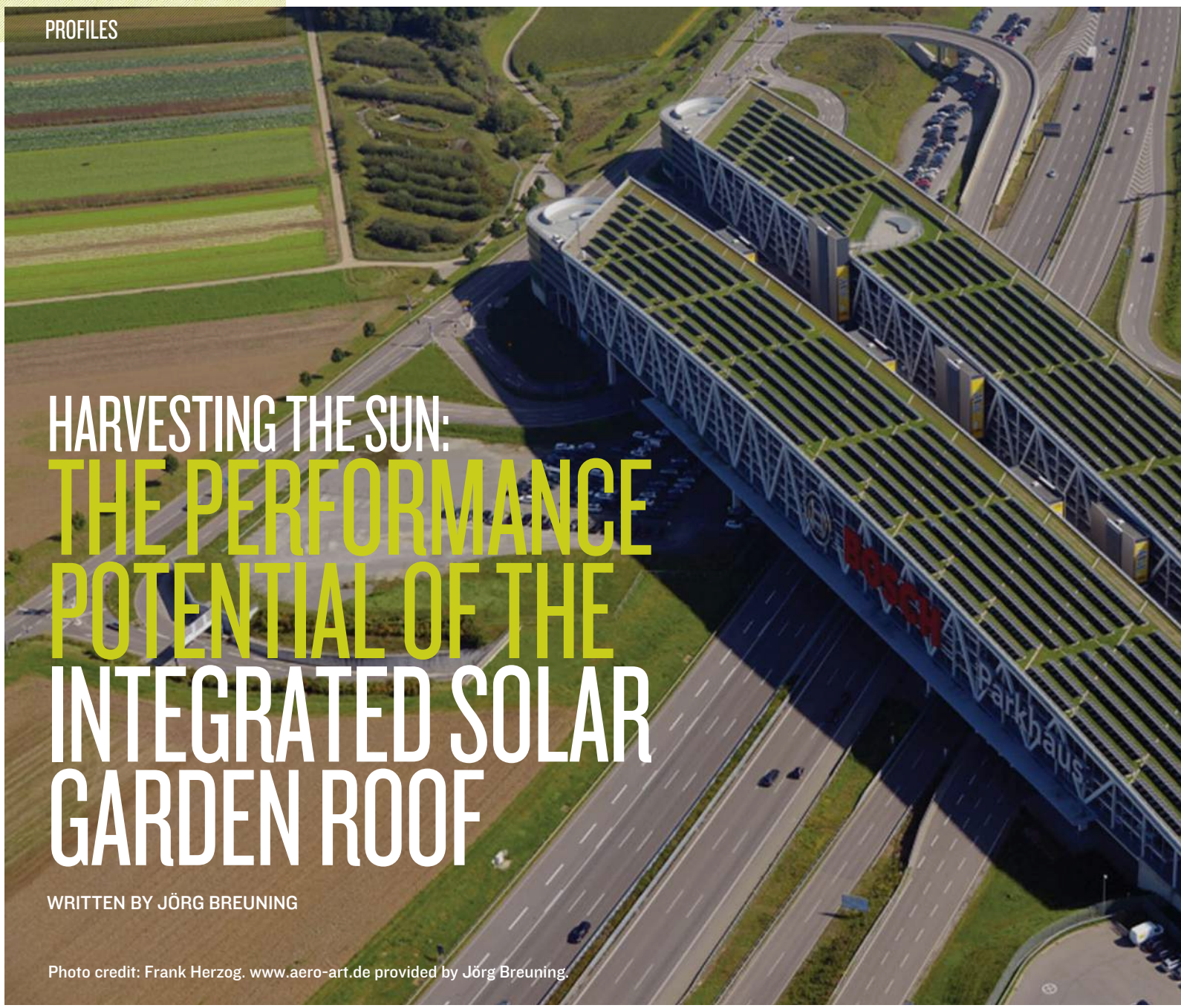
November 4, 1:00 - 4:00 pm / $29

Tour the 10-acre mixed use urban revitalization site in the heart of DC that includes green roofs on every building to achieve LEED for Neighbourhood Development Gold certification.

SIDWELL FRIENDS MIDDLE SCHOOL TOUR

November 4, 1:00 - 3:00 pm / $29

Visit the first K-12 school in the US and the first building in DC to earn a Platinum level LEED rating. Learn about the school's green building features including a constructed wetland used to treat wastewater for re-use on site.



HARVESTING THE SUN: THE PERFORMANCE POTENTIAL OF THE INTEGRATED SOLAR GARDEN ROOF

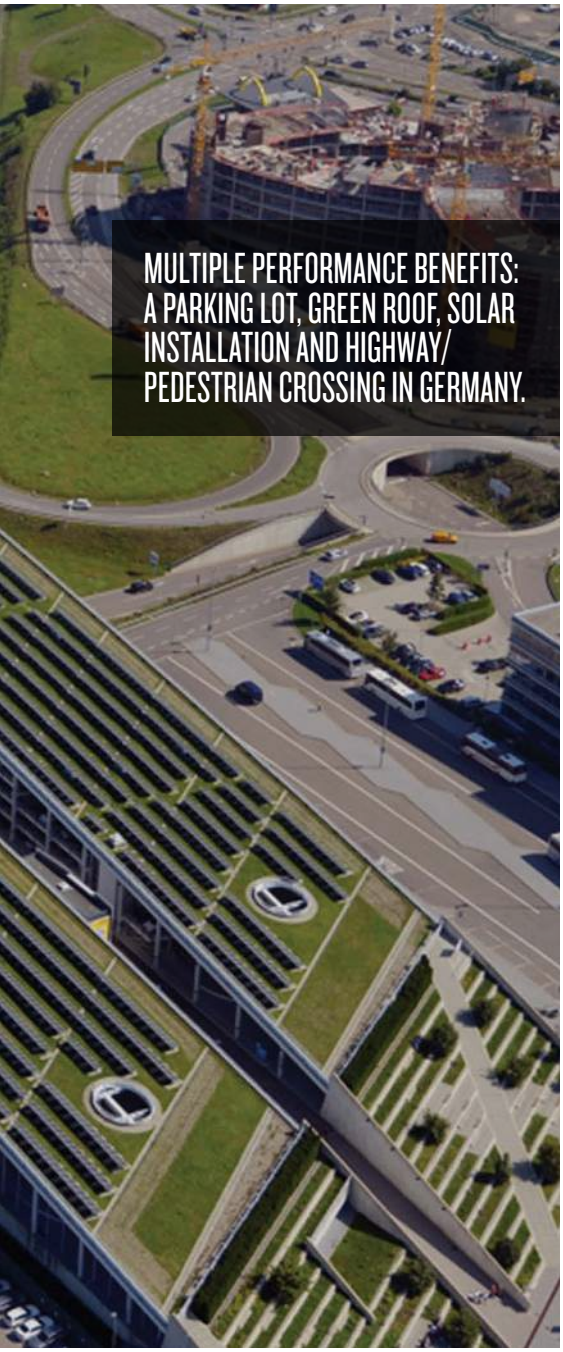
WRITTEN BY JÖRG BREUNING

Photo credit: Frank Herzog. www.aero-art.de provided by Jörg Breuning.

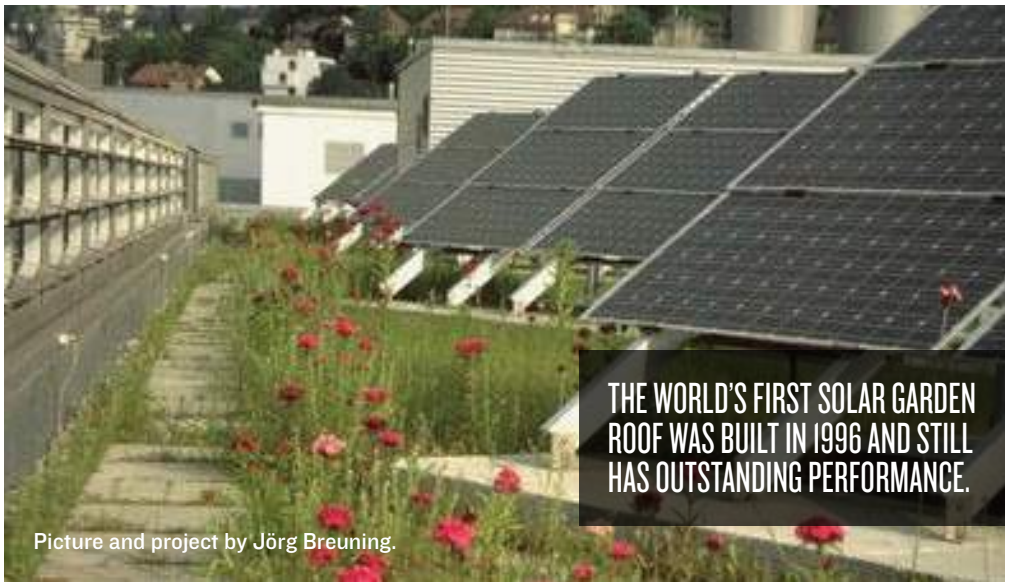
It is well known that green roofs reduce the environmental footprint of buildings by re-introducing nature to a place where it existed prior to the structure being built. Many of the economic and environmental benefits of living architecture on structures are now a given, having been adequately proven over the last 40 years in most countries around the world.

In 1999, and almost at the same time when green roofs started gaining popularity in North America, the boom for Photovoltaic (PV) or Solar panels on rooftops started. Many industry professionals from both technologies saw rooftop PV as competing with green roofs for empty roof spaces. Yet this does not have to be the case.

Twenty years ago, I installed the first project that combined PV and green roof without any penetration of the waterproofing membrane. The basic idea is that a roof can support multiple environmentally friendly technologies without sacrificing or compromising any benefits of either



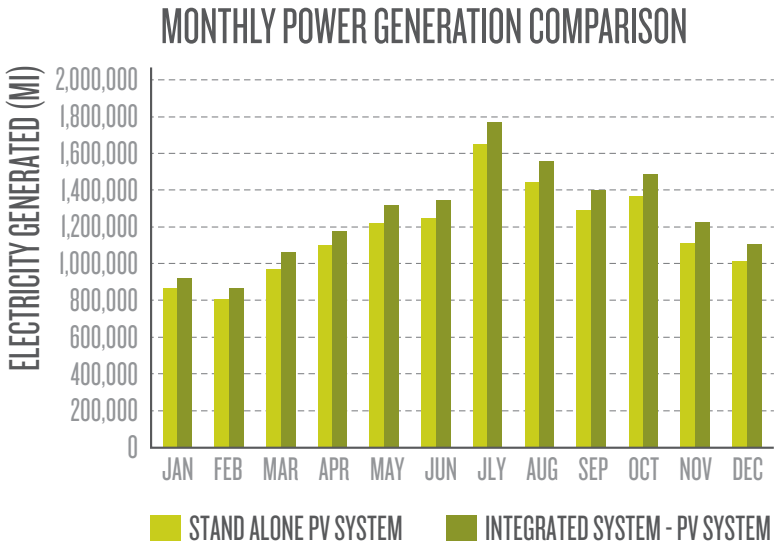
MULTIPLE PERFORMANCE BENEFITS: A PARKING LOT, GREEN ROOF, SOLAR INSTALLATION AND HIGHWAY/ PEDESTRIAN CROSSING IN GERMANY.



THE WORLD'S FIRST SOLAR GARDEN ROOF WAS BUILT IN 1996 AND STILL HAS OUTSTANDING PERFORMANCE.

Picture and project by Jörg Breuning.

TABLE 1:
GREEN ROOF SOLAR PV EFFICIENCY STUDY, CONDUCTED BY THE DEPARTMENT OF MECHANICAL ENGINEERING AT THE UNIVERSITY OF HONG KONG (2011)
COURTESY J. BREUNING



technology. Since then, the technology to combine solar, PV and green roofs has been developed further in Europe, resulting in at least three integrated systems currently on the market. A number of these systems have passed wind tunnel tests in Germany in excess of 100 mph and have developed techniques to efficiently support plant growth under the panels.

In 2010 I introduced the first combined system to North American industry experts. They were surprised, confused and wondering whether somebody was trying to break the wall between hardened fronts of solar warriors and green roof fighters? Today the technology is now so advanced that there is no reason for not combining these systems when the opportunity exists.

The solar lobby did some great work by establishing a nationwide and uniform incentive system, however green roof incentives differ from city to city, and in many cases don't exist. This incentive challenge is the best opportunity for combining smart PV solutions with modern green roof technology and without roof penetration, which would otherwise generate concerns about possible leaks. For example, it is possible that certain components of the green roof, such as ballast/growing media may be covered by solar incentives because they are part of both technologies.

In addition, knowing that the ambient temperature of green roofs is much lower than traditional roofs - whether black or white - means that solar engineers know it will improve the efficiency of PV modules. This is because PV modules work best at generating electricity at around 24°C or 75°F. With increasing ambient temperatures on a traditional roof (up to 70°C or 150°F) PV panels can lose tremendous electricity output or even in extreme cases, shut down. The ambient temperature of green roofs rarely exceeds 40°C or 100°F and this cooler environment makes rooftop mounted PV with greenery more efficient at generating electricity.

Different studies have proven that PV on a green roof has five per cent to 15 per cent higher output put during hot seasons. (See Table 1.) More large-scale study (over 20,000 sf), would likely demonstrate even better efficiency performance gains because of even greater reductions in the ambient temperatures. Despite this initial research, opponents of integration cite that there isn't enough research, or the data is based on projects that are too small-scale. Meanwhile every kid knows that standing on a parking lot in summer is much hotter than standing on a lawn in a park. Maybe these kids wonder whether the costly search for even more data might be much better invested in just doing it.

Another reason is the hesitation of unrestrained and open-minded collaboration between solar companies, green roof professionals, architects, landscape architects, and building owners. A Solar Garden Roof (combing both technologies) can add more value to relevant industries, if they are willing to work collaboratively. Fully integrated systems can be built on any type of waterproofing without effecting roofing warranties.When correctly engineered and installed Solar Garden Roofs certainly out-compete an extensive green roof without PV or a PV roof without living green. (See Table 2.)

As the green roof and solar roof top industries continue to evolve, the business case for the integration of these technologies should help drive the market to much greater use of roof spaces across North America.

Jörg Breuning is the president of Green Roof Service, LLC.

(1) Assuming 5% higher output because of cooler ambient temperatures
(2) Racking system average costs
(3) Includes fully integrated racking system
(4) Average costs in DC, non-union job, no roofing company as middle man
(5) Assuming Roofing is done beyond common industry standards
(6) Average max. temperature on 10 square foot, sunny summer day, air temperature 85°F

TABLE 2:
COMPARISON OF REFLECTIVE, EXTENSIVE GREEN AND TWO TYPES OF SOLAR GARDEN ROOF SYSTEMS FOR A GREEN ROOF IN WASHINGTON, DC
COURTESY J. BREUNING

SYSTEM CHARACTERISTICS	REFLECTIVE ROOF (NO PV AND NO GREEN)	EXTENSIVE GREEN ROOF 5" DEPTH	SOLAR ROOF 10° (NO GREEN)	SOLAR GARDEN ROOF 15° ANGLE 5" DEPTH	SOLAR GARDEN ROOF 30° ANGLE 5" DEPTH
MAX. AVERAGE WEIGHT PER SQUARE FOOT	2 lb / sf	28 lb / sf	10 lb / sf	35 lb / sf	35 lb / sf
ANNUAL WATER RETENTION	0 gal.	14,700 gal.	0	14,700 gal.	14,700 gal.
WATER RETENTION OF STORM EVENT	0	2" storm	0	Min. 2" storm	2" storm
AMOUNT OF SOLAR PANELS (PREMIUM 330W)	0	0	270	252	180
PV ROWS (LONG SIDE OF BUILDING FACING SOUTH)	0	0	15	7	10
PV ORIENTATION	No	No	Landscape	Portrait	Landscape
POWER OUTPUT SYSTEM	0.0 kW	0.0 kW	89.1 kW	83.1 kW	59.4 kW
SYSTEM LOSSES (HEAT, TILT, SNOW, ETC.)	0%	0%	18.63%	14.11%(1)	14.11%(1)
ESTIMATED ANNUAL POWER OUT FOR LOCATION	0.0 kWh	0.0 kWh	104,012 kWh	105,392 kWh	78,420 kWh
SAVING COOLING / HEATING ENERGY BUILDING	2%	10%	0%	12%	12%
MAXIMUM SURFACE TEMPERATURE(6)	140°F	95°F	130°F	90°F	90°F
REDUCING HEAT ISLAND EFFECT	No	Yes	No	Yes	Yes
RACKING SYSTEM REQUIRED	No	No	Yes	No	No
ROOFING SYSTEM EXPOSED TO ENVIRONMENT	Yes	No	Yes	No	No
ROOFING SYSTEM PROTECTED AGAINST IMPACT(5)	No	Yes	No	Yes	Yes
ELIGIBLE FOR STORMWATER FEE REDUCTION	No	Yes	No	Yes	Yes
ELIGIBLE FOR GREEN ROOF INCENTIVES	No	Yes	No	Yes	Yes
ELIGIBLE FOR SOLAR TAX CREDIT (30%)	No	No	Yes	Yes	Yes
ELIGIBLE FOR SREC IF AVAILABLE	No	No	Yes	Yes	Yes
HABITAT FOR PLANTS AND INSECTS	No	Yes	No	Yes	Yes
MAINTENANCE REQUIRED	Yes	Yes	Yes	Yes	Yes
ESTIMATED INSTALLED COSTS W/O PV	$14.00/sf	$18.00/sf	$5.00/sf(2)	$21.00/sf(3)	$22.00/sf(3)
PROJECT COSTS FOR PV INSTALLED PER SF ROOF	$0	$0	$9.45	$8.82	$6.30
ESTIMATED ENTIRE PROJECT COSTS(4)	$140,000	$180,000	$144,500	$298,200	$283,000
TYPICAL DC GREEN ROOF INCENTIVE	$0	$150,000	$0	$150,000	$150,000

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HOW MUCH WATER DOES A GREEN WALL USE? GRHC WADES IN!

GRHC is looking for water use data from your green wall! Please contact bstand@greenroofs.org

WRITTEN BY BLAINE STAND AND MELISSA DANIELS

Photo courtesy of Melissa Daniels

Green Roofs for Healthy Cities' (GRHC) Green Wall Industry Committee recently made a deputation to the USGBC's Water Efficiency Technical Advisory Group (WE TAG). The Committee is in the process of reviewing water use baselines for green wall installations and how green walls were scored in the LEED rating systems, with an emphasis on eliminating potable water use in these systems. GRHC described the many different types of green walls, and the factors at play in green wall installations that impact water use, and how they might be affected by changes in LEED scoring.

The green wall industry is still a young market, with a variety of new and very different systems being developed every year. Water use in green wall systems is affected by a variety of factors such as the type of system installed; the type of irrigation system and controller used; the climate in which the wall is installed; wind or solar exposure on the wall; maintenance practices and plant selection. With all these factors at play, GRHC argued that it is difficult to apply a one-size-fits-all approach to regulating green wall water use. Other considerations include the source of water, such as the use of gray water, rainwater or condensate instead of potable water for green wall installations. Gray water for example, may come with a variety of health and safety restrictions. In addition, there are additional price considerations for gray water harvesting systems and integration could negatively affect green wall adoption in mainstream design. In some jurisdictions, there may be regulations that prevent the harvest of rainwater for irrigation purposes.

Since not all green walls utilize significant potable water, GRHC indicated that blanket potable water use restrictions through LEED could negatively impact market growth and unfairly punish systems designed for minimum water use. GRHC recommended that a more progressive option might be to reward good design by granting credits based on the use of high efficiency irrigation systems and irrigation controllers, rather than restrict credits based on overall water use. The committee presented water use statistics for several living wall systems (see right) and indicated that more research would help to better understand and develop best practices for wise water management in green walls. GRHC looks forward to continuing to work with the Technical Advisory Group to develop appropriate measures to ensure wise water performance for green walls.

CASE STUDY:

WATER PERFORMANCE BEST PRACTICES IN A GREEN WALL SYSTEM

The G-O2 living wall system is a soil-based, modular living wall system that employs many methods in its design to minimize potable water use. The soil media itself is a proprietary blend that employs anti-erosion materials and natural elements like humic acid to maximize efficient water movement through the soil media and make it readily available to plants. A water-wicking fabric insert in the aluminum or stainless steel modular panels is a second water-conservation feature that can store water in the panel for later availability for the plants to take up on an as-needed basis.

The design of the irrigation system of a green wall is the real key to minimizing water use and waste. Most green facades and many living wall systems commonly use highly efficient drip irrigation systems that have very low flow rates, so they can be metered to give plants exactly the water they need without waste. Drip irrigation also prevents water loss through evaporation into the air, as the water is delivered directly into the soil media where the roots of the plant absorb the water they need as it becomes available.

There are also a number of tools that can be used in conjunction with these high-efficiency, low water use drip irrigation systems to eliminate water waste. Flow sensors can be installed to measure the flow rates and irrigation timings so that one can monitor and measure exactly how much water is being used. These flow sensors are also helpful in detecting breaks in lines or valve malfunctions that could potentially lead to water waste. Soil moisture sensor equipment can also be employed when maintaining any green wall to monitor and adjust the irrigation settings to give plants exactly the right amount of water at the right time, This, in turn, minimizes or eliminates water waste or overflow into drainage systems.

Using equipment like that described here, two very large exterior living walls with an average yearly water consumption of less than a gallon per square foot for the entire year were maintained. The consumption rate is calculated using irrigation timing data from maintenance reports multiplied by the gallon per hour settings on the drip irrigation lines.

Blaine Stand is the Membership Coordinator for Green Roofs for Healthy Cities and Staff Liaison for the GRHC Green Wall Industry Committee. Melissa Daniels, CNLP is the Vice President of Plant Connection and Co-Chair of the GRHC Green Wall Industry Committee.Plant Connection and Co-Chair of the GRHC Green Wall Industry Committee.

UPDATE ON THE LIVING ARCHITECTURE PERFORMANCE TOOL PROGRAM

WRITTEN BY ROHAN LILAUWALA

If you are reading this magazine, you are most likely aware of the many social, economic, and environmental benefits offered by living architecture. However, the variation in living architecture products, design, installation, maintenance and context make these benefits complex to measure, especially for those outside the industry. This complexity threatens to undermine the long-term future of living architecture, and often means that green roofs and walls are not considered when devising solutions for problems that occur in our built environment.

The Green Infrastructure Foundation has been developing the Living Architecture Performance Tool (LAPT) program to develop science-based performance criteria and metrics for all major types of living architecture, beginning with green roofs. The program objective is to ensure that living architecture projects will achieve certain performance benefits, so that they can be funded and implemented with confidence. By aligning with the needs of policy makers like municipalities and water utilities, as well as with rating systems like LEED and SITES, the LAPT aims to strengthen the long-term outlook for living architecture.

The LAPT has been under development since 2010, but much of the background work surrounding it has been conducted in the last two years. White papers on the subjects of Energy Conservation and Generation, Biodiversity, Biophilic Design, Stormwater Quality, and Maintenance and Operations are in the first draft stage. A white paper on the subject of Stormwater Quantity Management

has received comments and feedback from expert-attended workshops and the white paper now includes a recommendation for a final metric.

Moving forward, the Green Infrastructure Foundation is working on completing a draft framework for the LAPT, soliciting feedback on white papers from experts in any area of living architecture performance, and seeking partner organizations to contribute to these important efforts. The ultimate goal is clear: to ensure living architecture performance and continue to advance this growing industry.

Rohan Lilauwala is Senior Researcher at Green Roofs for Healthy Cities.

FIND OUT MORE

Read more about the LAPT, including the draft white papers at greeninfrastructure-foundation.org/lapt. For questions and comments, contact Rohan Lilauwala at rlilauwala@greenroofs.org

ARE YOU READY FOR GREEN ROOFS THAT PRODUCE ELECTRICITY?

WRITTEN BY KARA ORR

The goal of alternative energy technology researchers is to create a new source of electricity generation technology that is renewable, sustainable, and accessible, and green roofs may just hold the key! So when Marjolein Helder, the Dutch CEO of Plant-e completed her 2012 thesis entitled *Design criteria for the Plant-Microbial Fuel Cell Electricity generation with living plants – from lab to application* she was seeking to realize the potential of plant based electricity generation.

Marjolein explains, "to meet future electricity demand, alternative electricity generating technologies are needed. A new alternative electricity generation technology is the Plant Microbial Fuel Cell (P-MFC)". The Plant Microbial Fuel Cell is described in Helder's thesis as a "system that produces bio-electricity from plant derived organic matter without harvesting the plant". The P-MFC technology uses rhizodeposits released from plant roots, which are then converted into electrons, protons and CO_2 by electrochemically active micro-organisms that are present around the roots. These electrons are harvested using anodes and cathodes separated by a membrane to produce electricity.

The P-MFC technology is *renewable* because the energy it outputs in its lifetime offsets the energy required to produce it. This method of generating electricity is *sustainable* because it can continue to output energy so long as water remains in a liquid form. Because of

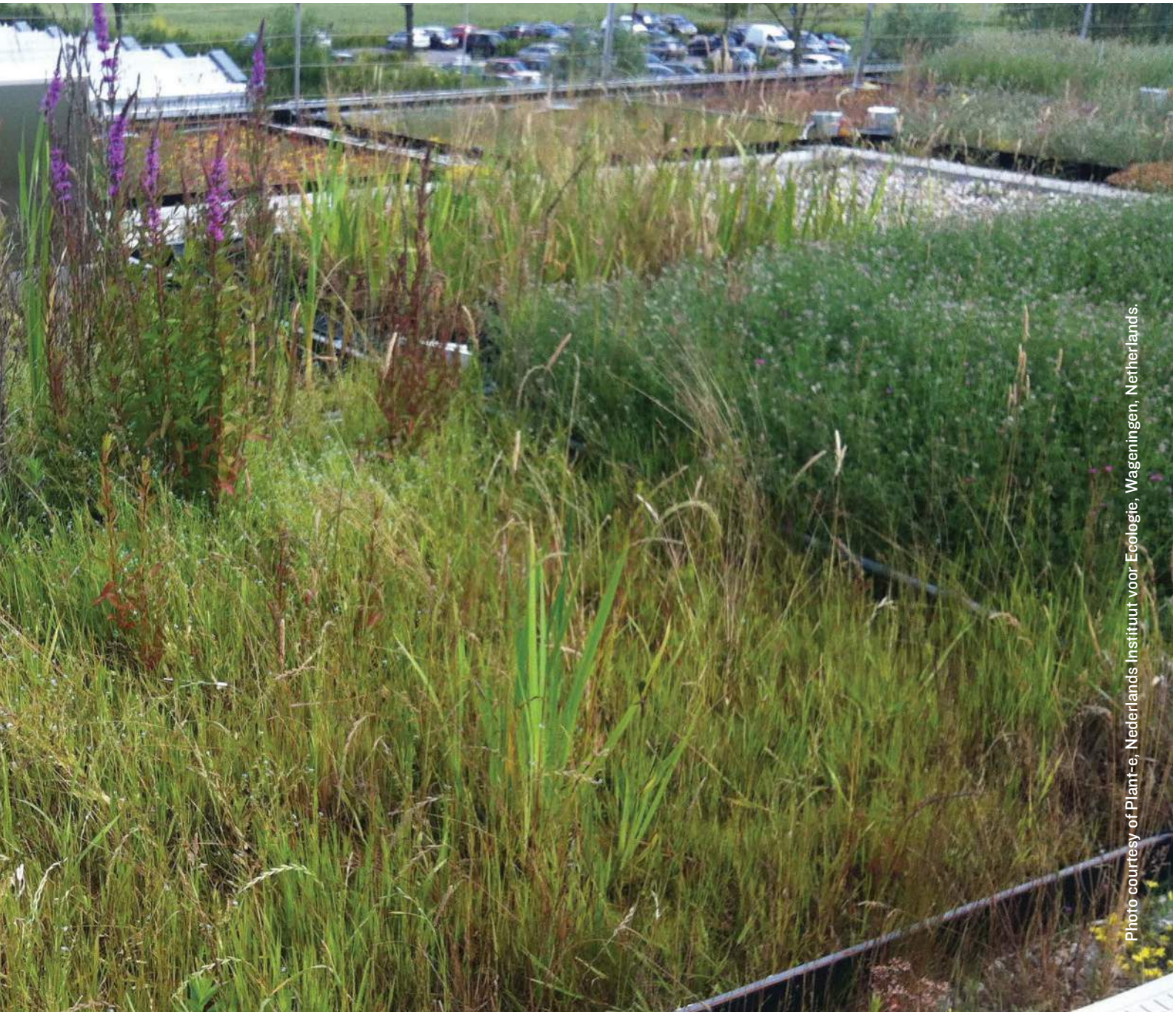

Photo courtesy of Plant-e, Nederlands Instituut voor Ecologie, Wageningen, Netherlands.

the nature of this technology it is *accessible* wherever water is available and plants can grow.

Ready for consumers to experiment with, P-MFC based at-home kits are now available to purchase through Plant-e. Plant-e is an offshoot organization focused on creating consumer-grade applications for P-MFC technology, formed by Marjolein Helder and David Strik, of the Environmental Sub-department at Wageningen University in the Netherlands. Plant-e now sells modules that can be constructed for homes and can light up LED ornamental lights.

As for developing large-scale modules, Plant-e continues to research the use of natural energy flows, light, carbon dioxide and water to create electricity. The "largest modular system [developed is] 100 square meters and the 400 modules can generate electricity that can be used for blinking LEDs, LED strips, or decorative light objects" notes Plant-e's Jacqueline Hoogendoorn-Niemeijer. She believes that the green roof industry can utilize this technology to help light the buildings they top, among other applications. Applying Marjorein's findings, and Plant-e's technology, may provide more accessible living conditions for residents by reducing electricity costs. And, if these practices are adopted within North America, perhaps they can also be adopted by developing countries to help light their way too.

Kara Orr is the Marketing Coordinator for Green Roofs for Healthy Cities.

FIND OUT MORE

Marjolein Helder's thesis, *Design criteria for the Plant-Microbial Fuel Cell Electricity generation with living plants – from lab to application*, can be found here: http://www.gbv.de/dms/tib-ub-hannover/78648652x.pdf
Plant-e: http://www.plant-e.com/en/

NEW CORPORATE MEMBERS

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Founded in 2004, with offices in Florida and British Columbia, GSky® Plant Systems, Inc. is a leading provider of vertical Living Green Walls in North America, Europe, Australia and the Middle East. The company was founded based on the explosive growth of green technology. GSky® currently has more than 400 installed or under contract Living Green Walls representing over 160,000 square feet across three Green Wall Systems: the Pro Wall®; the Versa Wall®; and the Basic Wall®. GSky® strives to make plant systems more accessible and functional in urban environments while having a net positive impact on the environment..

Riverbend Nursery / riverbendnursery.com
Riverbend Nursery is a progressive container grower of over 2.5 million containers and 1100 varieties annually of quality perennials, herbs, groundcovers, and ornamental grasses as well as supplier of LiveRoof systems. A wholesale only grower located in Riner, Virginia, Riverbend sells to independent garden centers, landscapers, and distributors. With over 50 acres for plant production and a dedicated 40 acre farm for their LiveRoof production, which has allowed them to increase plant production and improve their LiveRoof distribution capacity, you can count on Riverbend to deliver premium plants that customers love.

Rooftop Green / growrooftopgreen.com
Rooftop Green's primary objective is to make green roofs accessible to anyone and everyone. With our ultra-low-cost manufacturing process, our product is a fraction of the cost of typical vegetated roof systems. We have taken a DIY approach, creating all- inclusive modules that are focused on ease of installation and low-level maintenance. Our unique design is based on a patented thermoformed tray made of post-consumer recycled water bottles, making our product not only innovative, but inexpensive. Rooftop Green believes in the power of green space. With the support of our parent company, Dan T. Moore Co., we hope to increase that green space in Cleveland and beyond.

Sedum Master / sedummaster.com
Sedum Master is a family business with three generations of agriculture expertise and experience in ecological stabilization. Operating in the green roof industry for 10 years with over 14 years experience, we specialize in providing sedum solutions for a variety of green roof applications and are dedicated to creating flexible relationships with customers to achieve individual project goals and ensure prompt service and delivery. With over 140 different sedum species available as single specie or custom mixes in a variety of blankets, mats or cutting arrangements, Sedum Master has the right plants for your green roof, lawn replacement, decor or arts & crafts projects.

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- Online Training: October 3rd to December 11th
- Portland: October 4th (in conjunction with Portland Ecoroof Symposium)
- New York: October 13th to 15th
- San Francisco: November 17th to 19th
- Washington, DC: December 1st to 3rd

NET ZERO WATER FOR BUILDINGS AND SITES
- Online Training: September 12th to November 6th

GREEN ROOF PROFESSIONAL (GRP) ACCREDITATION EXAMS
- Washington, DC: November 1st (in conjunction with CitiesAlive Conference)

MIAMI GREEN ROOF AND WALL SYMPOSIUM
- November 2016 (Date TBD)

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WHY WE NEED TO STANDARDIZE LIVING ARCHITECTURE PERFORMANCE: OPPORTUNITIES AND CHALLENGES

WRITTEN BY DAVID YOCCA

Living architecture offers immense potential to improve the built environment for people and the natural environment in a number of profound ways. So why are green roofs, green walls, and other forms of living architecture not more widespread? Following are three key reasons:

INSUFFICIENT ALIGNMENT WITH GREEN BUILDING TOOLS

High-performance building and site tools such as LEED, SITES, the WELL Building Standard, and the Living Building Challenge have fostered enormous strides in building performance over the past decade, and have helped to promote the use of living architecture substantially. However, the valuation of specific performance benefits for rainwater attenuation, water balance, energy reduction, biophilic space, and other benefits within these frameworks is often not clear or even contradictory, making it difficult for architects, engineers and other designers to capitalize fully on living technologies.

LACK OF INCENTIVES/POLICY SUPPORTS

Many benefits that are derived from green roofs and walls accrue to the larger neighborhood, district, or watershed. Flood reduction and water quality improvements reduce negative impacts caused by decades of urbanization and the costs should be distributed accordingly. The best short-term way to fairly balance the costs and benefits for district-scale application of living architecture is to enact policies to support green roofs and walls, and incentives to redirect costs associated with stormwater runoff impacts toward living technologies. This takes political will, and confidence in the performance characteristics of green roofs and walls.

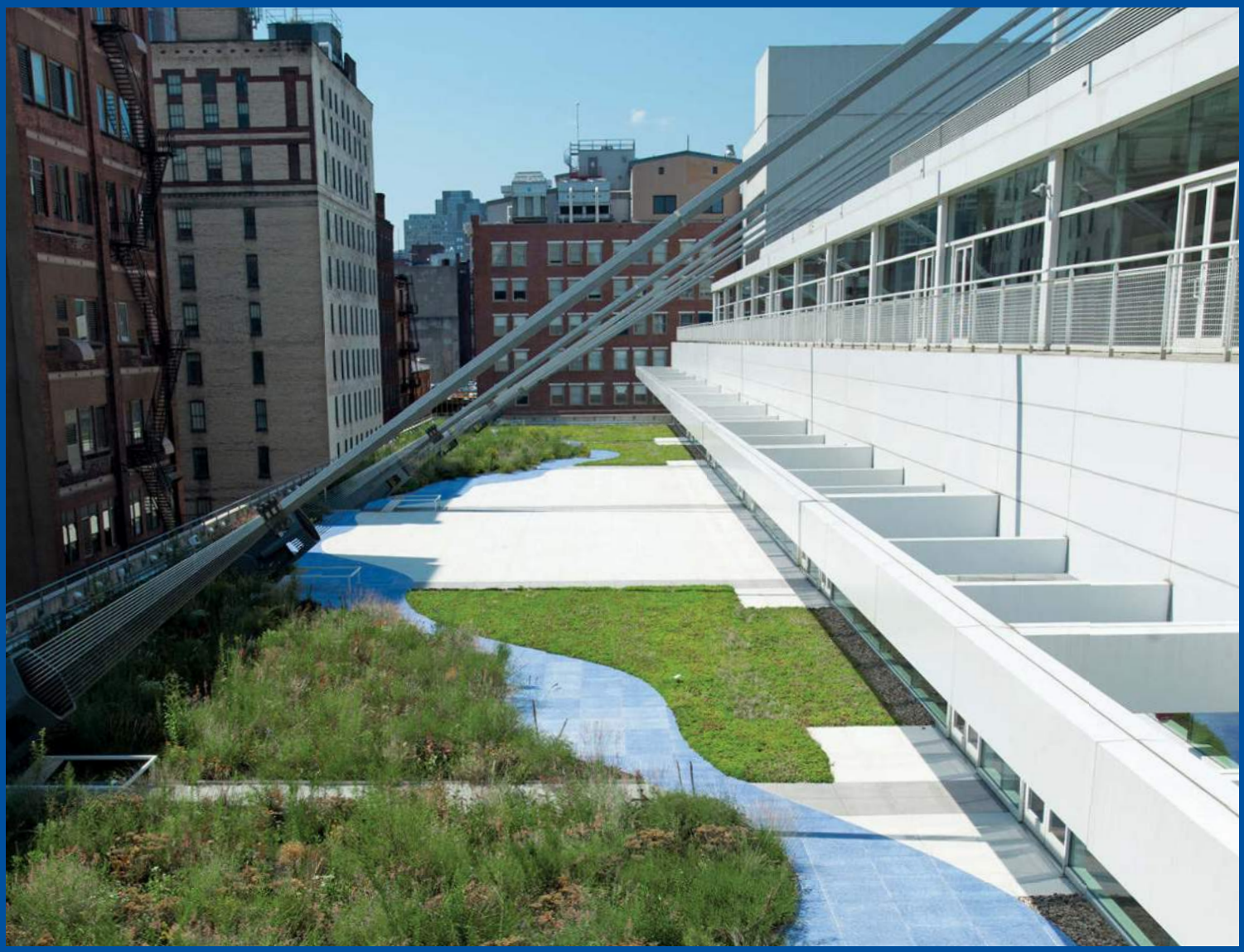
FEAR OF FAILURE/LACK OF CONFIDENCE IN PERFORMANCE BENEFITS

While there has been a great deal of measurement and quantification of green roof performance benefits, it is by no means exhaustive. There are many variables that impact performance, including geographic context, variations in systems components, maintenance and operations, and integration with other green infrastructure technologies. Also, there are examples of green roofs that have failed in some way, often due to maintenance neglect. Many building professionals remain unfamiliar with living architecture systems. Many local markets still do not have the local expertise to properly design, build, or maintain green roofs and walls. Thus, there is sometimes reluctance to enact policies and incentives, or even to adopt living architecture to specific projects, due to trepidation about potential benefits.

So then, how can we better capitalize on living technologies and capture their myriad benefits as millions of square feet of buildings are built or renovated over the next several decades? If we (living architecture experts) can agree on a comprehensive list of performance benefits, metrics and standards based upon experience and existing research, then policy regulators and elected officials can have more confidence to enact more aggressive initiatives and regulations promoting and/or requiring the use of green roofs and walls, especially where public funds are being used. This is one of the major goals of the Living Architecture Performance Tool program (LAPT). High-performance building and site tools will help to elevate living architecture performance to an appropriate, consistent measurement relative to other building strategies. Architects, engineers, regulators, and investors would all gain the knowledge to best integrate and benefit from the use of living systems in new and retrofit buildings, sites, neighborhoods, and campuses. The Living Architecture Performance Tool program can lead to healthier, more prosperous and competitive communities throughout North America.

David Yocca, FASLA, GRP is co-leading the development of the Living Architecture Performance Tool program, led by the Green Infrastructure Foundation (GIF). David is a Principal Landscape Architect/Planner with Conservation Design Forum, and a Board Member of Green Roofs for Healthy Cities.

Governmental Complex, Sejong, SouthKorea. Photo credit Efrain Mendez, BA.



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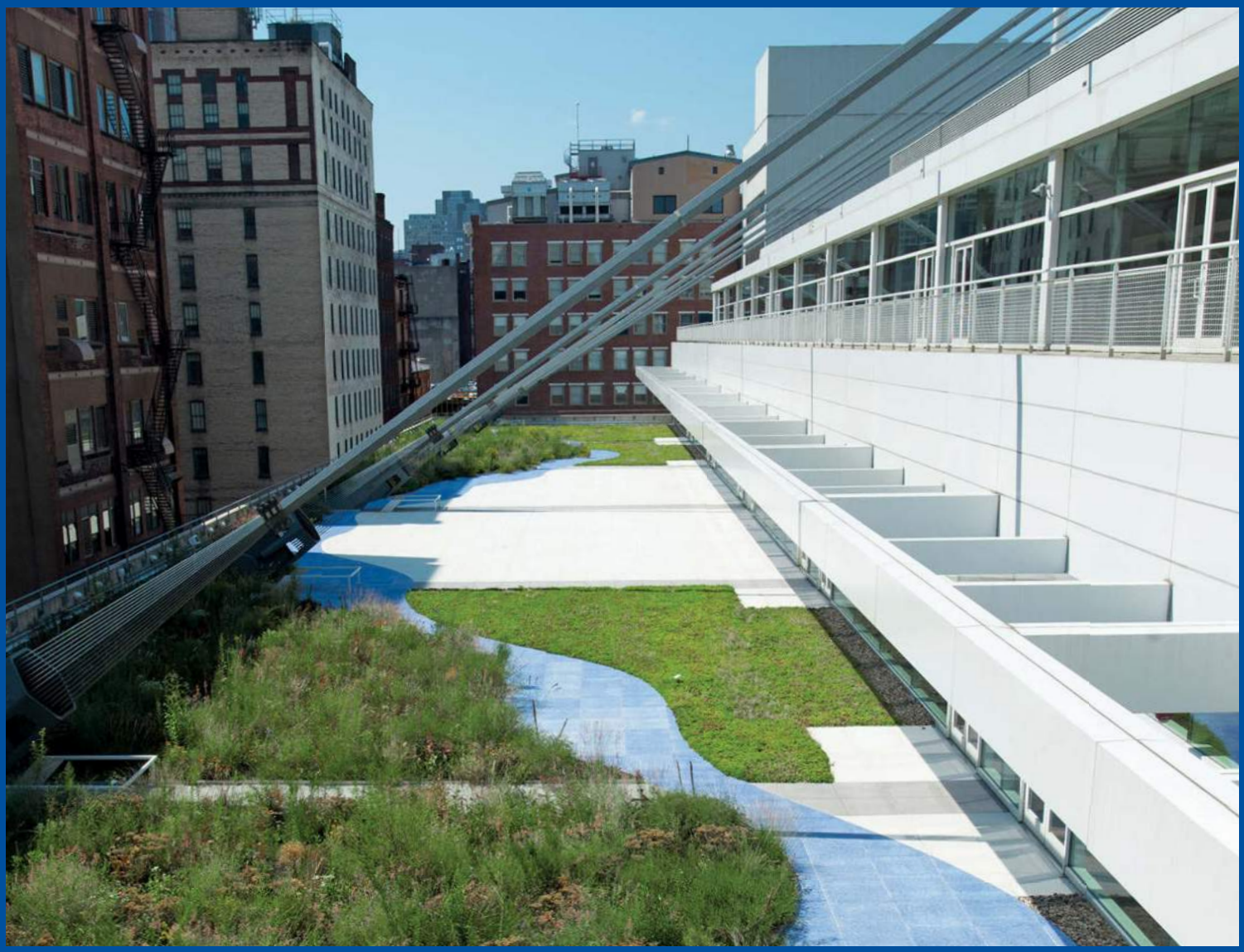

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