DISAPPEARING COASTLINE = DISAPPEARING CITIES

LIVING ARCHITECTURE MONITOR®

A GREEN ROOFS FOR HEALTHY CITIES PUBLICATION

VOLUME 19 / ISSUE 1 / SPRING 2017

THE CLIMATE CHANGE ISSUE

- Experts Reflect on Climate Change, Cities and the Need To Scale Up Green Infrastructure
- Starchitect Ed Mazria on the 2030 Challenge and How Designers Can Beat Climate Change
- The Evolution of the Awards of Excellence Winning California Academy of Sciences
- Update on Wind Standards
- New Creative Applications of Green Façades

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MAY 8-10, 2017
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VOLUME 19
ISSUE 1
SPRING 2017

INSIDE

On the Cover: What North America's eastern shoreline will look like if all of the ice on earth meltsand sea levels rise more than 200 feet. Source: Treat, Jason/National Geographic Creative

LIVING ARCHITECTURE MONITOR

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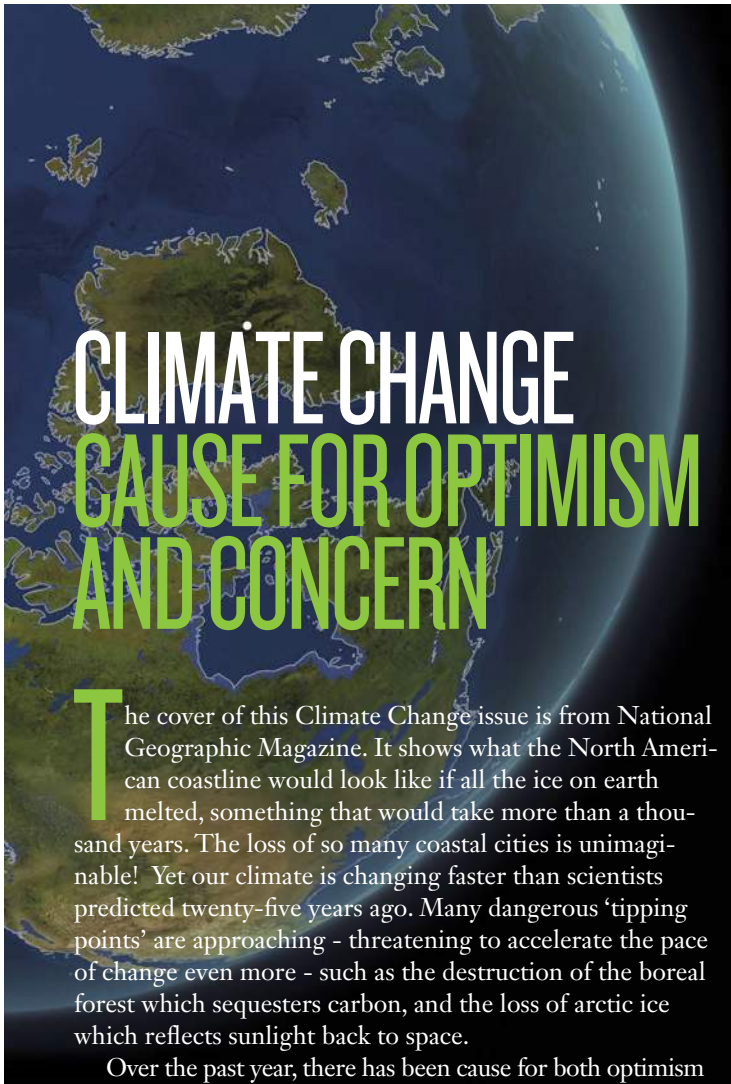


CLIMATE CHANGE
CAUSE FOR OPTIMISM AND CONCERN

The cover of this Climate Change issue is from National Geographic Magazine. It shows what the North American coastline would look like if all the ice on earth melted, something that would take more than a thousand years. The loss of so many coastal cities is unimaginable! Yet our climate is changing faster than scientists predicted twenty-five years ago. Many dangerous 'tipping points' are approaching - threatening to accelerate the pace of change even more - such as the destruction of the boreal forest which sequesters carbon, and the loss of arctic ice which reflects sunlight back to space.

Over the past year, there has been cause for both optimism and concern. Green buildings, renewable energy, green roofs and walls are all part of the solutions cities need to both mitigate and adapt to climate change. We have many of the technologies required to reduce greenhouse gases, but the question is whether we have the social and political will to rapidly deploy them in the face of powerful and entrenched interests. The new Trump administration has the power to accelerate the pace of positive change, and make America a cleantech, green infrastructure and energy superpower, or, it can hamper progress. Here's a quick recap of the past year in this 2017 LAM INDEX.

This issue is dedicated to exploring the intersection of green roofs and walls and climate change! We have the solutions; what we need is to marshal the resolve to implement them.

Sincerely yours,

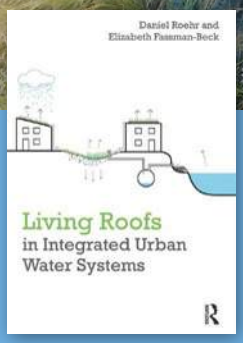
Steven W. Peck,
GRP, Honorary ASLA
Founder & President

1. NASA records the hottest year on record for global temperatures – 2016
2. Year when the Arctic is predicted to be totally ice free in the summer – 2030
3. Amount of the sun's energy reflected by sea ice preventing it from warming the ocean – 70%
4. Intergovernmental Panel on Climate Change projected sea level rise by 2100 from melting of Antarctic and other ice – 19 to 23 inches
5. Current loss of coral in one-third of the Great Barrier Reef off the coast of Australia – 50%
6. Number of countries that signed the Paris Agreement and agreed that climate change is an urgent problem that requires immediate action – 193
7. Temperature rise target needed to avoid catastrophic and irreversible climate change – 2 degrees C
8. Number of countries that have ratified the Paris agreement – 117
9. Estimated percentage of fossil fuel reserves of the top 100 coal, oil and gas companies that can be burned while still remaining at the 2ºC temperature target – 20%
10. Number of coal-fired electricity plants under construction or planned recently cancelled by China – 103
11. World's electricity in 2015 that comes from renewables – 28%
12. Percentage drop in the cost of utility-scale solar energy from 2015-16 – 12%
13. International Energy Agency projected growth in renewables 2015-2021 – 42%
14. Total dollars (US) currently committed to divesting in the fossil fuel industry as of 2016 – $5.2 trillion
15. Number of jobs created from $1 million invested in the oil and natural gas industry – 0.8
16. Number of jobs created from $1 million invested in retrofitting buildings for energy efficiency - 7

Image Credit: Treat, Jason/National Geographic Creative

LIVING ARCHITECTURE DOCTOR

This living wall profiled in the Winter 2016 Issue of the LAM is suffering from either a lack of sufficient light, or irrigation which has caused the plants to begin to fail. Proper light and irrigation are absolutely essential for success of vertical greening. Select a species that requires less light and check the irrigation system and replant.



BOOK REVIEW: LIVING ROOFS IN INTEGRATED URBAN WATER SYSTEMS, (2015) ROUTLEDGE

Daniel Roehr, Associate Professor, University of British Columbia teams up with Dr. Elizabeth Fassman-Beck, Stevens Institute of Technology to combine the fields of landscape architecture and civil engineering to produce a resource on how to effectively design green roofs for effectively mitigating storm water. Quantitative tools for engineering calculations are provided. Purchase the book here: https://goo.gl/BIVKSN

THE NEW LANDSCAPE DECLARATION: A CALL TO ACTION FOR LANDSCAPE ARCHITECTURE

The Landscape Architecture Foundation (LAF) has released the New Landscape Declaration, a 21st century call to action for the landscape architecture community. The Declaration is the synthesis of the ideas from LAF's historic Summit on Landscape Architecture and the Future held in Philadelphia last June. LAF is now encouraging built environment professionals across the globe to sign on to this ambitious vision and assert the vital role of landscape architecture in solving the defining issues of our time: climate change, species extinction, rapid urbanization, and inequity. To read and sign on to the Landscape Declaration visit: lafoundation.org/declaration

GROUP FORMING TO ACCELERATE GREENING OF THE BIG APPLE

Living Architecture New York (LANY) is a new citizens group that is forming in New York City with a mission to advocate and educate for policies, incentives and direct investment to dramatically accelerate the implementation of green roofs and walls. LANY is currently canvassing for Charter Members ranging from $2,500 to $25,000. Charter members currently include: Long Island Compost, Plant Connection and Metro Green Visions. For more information or to attend the March 15th launch event, visit livingarchitecture.nyc.

DENVER MOVES TOWARDS MANDATORY GREEN ROOFS

On the heels of San Francisco's green roof and/or solar panels mandate, a Denver based grassroots citizens group recently gained approval from the City to have a green roof initiative on the November 2017 ballot. They must now collect nearly 10,000 signatures over the next 180 days. Brandon Rietheimer, a member of the Denver Green Roof Group said they are using Toronto's green roof bylaw as a guiding model for the policy. You can find the initiative proposition and more about the Denver Green Roof group at denvergreenroof.org.

WGIC 2017 BERLIN.com
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The FBB in Berlin is hosting the 10th Annual WGIN Congress June 18-21, 2017. For details go to: wgic2017berlin.com/en/registration.html

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Photo courtesy of Serena Matt

THREE EXPERTS REFLECT ON:

CLIMATE CHANGE, CITIES AND THE NEED TO SCALE UP GREEN INFRASTRUCTURE

KEVIN BEHAN, DR. DAVID R. TILLEY & DR. BRAD BASS

1. What are the main issues facing North American cities with respect to climate change?

Kevin Behan (KB): There are considerable, but separate issues facing North American cities around mitigating against, and adapting to climate change. Considering mitigation, much of the 'low hanging fruit' has now been picked. Many of our point source industrial greenhouse gas emissions have been regulated with controls in place. Future mitigation will rely on improvements to building energy and transportation efficiency. Fossil fuel companies continue to receive considerable subsidies to bolster their market competitiveness, so the cost of 'going green' is currently borne by the individual. All orders of government need to work together to create a level playing field where the negative external costs of fossil fuel energy are accounted for, increasing the attractiveness of renewables. Governments, developers and utilities need to work together to build the market for home efficiency and net zero ready homes.

Regarding adapting to climate change, we are now at (or indeed, past) the point where the implementation of adaptation projects must happen. Adaptation projects tend to have more localized benefits. Reflecting this, municipal governments have had little or no financial or resource assistance from higher orders of government to deliver adaptation projects. The absence of a concerted effort to build resilience in our cities remains a huge stumbling block to adaptation.

DT: The number of deadly summer heat waves that hit major cities is expected to increase in frequency and intensity as the climate warms. Excess urban heat is especially troublesome because the population of cities is growing and the mean age of city residents is increasing. The elderly tend to be more prone to suffering death and disease due to heat waves. Cities with the highest density populations and least amount of green space tend to suffer the most from heat waves. Flooding due to big storm events is also a major concern. The spread of hard surfaces for parking lots, buildings, roads and the loss of green space in cities exacerbate the damage caused by heat waves and floods.

BB: This will vary by cities. Some will deal with heat and the associated cooling costs and health impacts. Others will deal with water shortages or extreme flooding events (and associated water quality impacts). Coastal cities will need to address rising sea levels. Although I expect impacts on cities' ecosystems, I am not sure that these will be given much attention when cities are dealing with more extreme heat or water related issues.

2. How can increasing our use of plant based technologies (green infrastructure) in cities contribute to our ability to make them more resilient in the face of climate change impacts?

KB: Green infrastructure is essential for both climate change mitigation and adaptation. Climate change has resulted in dramatic changes to how our rain falls. While for many North American communities, overall annual levels of precipitation are relatively unchanged, the intensity, frequency and duration with which precipitation falls has changed considerably. Green infrastructure is essential and efficient in the management of stormwater. This is especially important in the face of increasingly frequent intense rainfall events. We are also seeing increased drought periods, green infrastructure is a cost effective way to retain soil moisture during dry spells, preventing plant death and maintaining urban biodiversity. Climate change means higher temperatures in our urban areas. Through passive cooling, green infrastructure helps mitigate these temperature increases.

DT: Plants are one the Earth's major tools for absorbing excess heat from the Sun. Plants do this naturally by the process of transpiration, that is, the water pulled up from the soil by plants is released through small openings in their leaves. This helps plants maintain leaves at a biologically conducive temperature (as opposed to overheating). When the water is released from the leaves it goes from a liquid to a vapor, which absorbs an enormous amount of heat and energy from the Sun. Therefore, green infrastructure such as green walls, green roofs, rain gardens, and other living technologies help cool the urban environment by removing the Sun's heat, which grey or traditional infrastructure cannot do.

BB: Plants and green infrastructure can help mitigating the impacts of flooding (essentially by slowing down the flow and retaining water) and heat (reducing the urban heat island, through evapotranspiration and shading).

3. How can green roofs and walls, specifically, help us address climate change mitigation and adaptation challenges?

KB: Through evapotranspiration and higher albedos, green roofs and walls reduce temperature buildup in buildings leading to reduced energy use, contributing to climate change mitigation. By reducing energy demand, green roofs decrease greenhouse gases. This is especially important during hot spells when air conditioning loads are maximized. Green roofs are also essential in on-site the management of stormwater, slowing runoff and improving the quality of runoff through filtration. Through the provision of stormwater management benefits, green roofs and walls can help us adapt to our changing climate.

DT: In our research with green walls, we saw that the amount of energy from the Sun reaching the walls of buildings could be cut almost in half (43%) when vegetation was present. The painted, wooden walls covered with plants had mean summertime temperatures of 90°F, whereas the uncovered walls were 102°F, a difference of 12°F. These differences can be greater if the walls are red brick, dark stone, stucco, or other absorptive materials, but likely less with light colored walls.

BB: Green roofs should reduce impact of extreme storms by reducing flow into drainage systems. They can be designed to divert excess water into storage to cope with issues of water shortages. In the models, green roofs help reduce the Urban Heat Island, although this is yet to be verified with a large-scale application in a city. Green roofs and walls can certainly help with the creation of habitat for migrating species as the climate changes.

4. How important is scale in achieving the benefits you have referred to in questions 2 and 3?

KB: It is because of the massive scale of grey infrastructure in our urban areas that we are faced with critical issues of extreme urban heat and flooding. Similarly, any attempt to combat these events requires a considerable upscaling of our green infrastructure efforts. While a single green roof can provide heat and stormwater benefits to the building below it, in order to provide community level benefits, considerable coverage is required. It is straightforward to alter a building's surface temperature through the installation of green infrastructure. To have a positive effect on the air temperature over a broader geographic area requires a concerted effort. As scale increases, implementation costs decrease and benefits increase.

BB: Scale will be very impor-

ON THE ROOF WITH:

Kevin Behan (KB) is Deputy Director with Clean Air Partnership. Kevin has an Honours Bachelor of Science from University College Dublin and post-graduate qualifications in Business Studies and Information Technology (Dublin Business School) and Spatial Analysis and GIS (McMaster University).

Dr. David R. Tilley (DT) is an Associate Professor of Environmental Science & Technology at the University of Maryland and co-founder of a new company called Livingcanopies.com which specializes in living umbrella technology.

Dr. Brad Bass (BB) has over 20 years of experience in green infrastructure research and policy (energy, water quality, biodiversity) and climate change adaptation. He led the development the first green roof building energy model and was awarded a Lifetime Achievement Award for his contributions to green roof research in 2012.

tant. Certain benefits such as flood reduction and reducing the urban heat island just cannot happen without a large scale adoption.

DT: The scale at which green walls and roofs are deployed to combat urban heat is important. Some research as suggested that at least 1/5th to 1/4th of a neighborhood would need to be covered to see an appreciable lowering of temperatures. However, green walls and living umbrellas can easily reduce temperatures in their immediate environments.

5. What needs to happen, as top priorities, in order to better utilize green infrastructure, to help us cope with climate change in our cities?

KB: Green infrastructure must be considered on par with grey infrastructure in government investments. Urban forests must no longer be the sole financial responsibility of the municipalities in which they are located. Municipalities need the authority to establish their own green development standards allowing them to better protect and foster green infrastructure.

Future building code changes must consider green infrastructure.

DT: There needs to be a two-pronged approach to increase the use of green infrastructure. Cities, states and the federal government need to increase funding to increase research and development on improving the utility of living technologies. Incentive programs, like the ones in Washington, DC and in several Maryland counties are good examples of how private-public partnerships succeed. Secondly, organizations like the US Green Building Council's LEED certification need to award more points for green infrastructure.

BB: Green infrastructure is primarily a technology for adaptation to climate change. The adaptation side of the climate debate has always been given less attention than the greenhouse gas mitigation debate. I think this is changing as we are hit with more extreme events. I am not sure that we have a proper private and public valuation of green infrastructure that accounts for reducing the impacts of climate change.

6. In particular, what do you think the design community can do to accelerate our ability to address climate change challenges?

DT: Architects, landscape architects, planners and engineers need to work together closely to promote and expand green infrastructure projects, and, most importantly, share their successes and struggles with others in the professional and academic communities so progress on products and projects can continue.

BB: For green walls, I think there are opportunities to combine these technologies with large scale biofiltration. This would help in reducing the impacts of extreme storm events. The challenge for roofs is to move to highly biodiverse roofs as they will be cooler and more resilient, but the roofs will have to be designed with more water storage off the roof to better balance the more extreme variability that is expected in the future.

FIND OUT MORE

"Green and cool roofs to mitigate urban heat island effects in the Chicago metropolitan area: evaluation with a regional climate model" by A Sharma, P Conry, H J S Fernando, Alan F Hamlet, J J Hellmann and F Chen at University of Notre Dame.

BEYOND SEDUM: ALLIUM SPECIES FOR GREEN ROOFS

DR. BRADLEY ROWE, MICHIGAN STATE UNIVERSITY, EAST LANSING

Photo courtesy of Bradley Rowe

Various species of Sedum are the workhorses of extensive green roofs. However, it is not wise to rely on one genus in any landscape, regardless of whether it is located on a roof or at ground level. The genus, Allium, is one group of plants that can complement sedum or be grown with other plant species.

Alliums are herbaceous perennials that grow from bulbs, produce showy flowers on scapes (long, leafless flowering stems), and often have an onion-like odor and taste. Common species within this genus include onions, garlic, scallions, leeks, and chives. There are hundreds of wild alliums, many of which are cultivated for food and as ornamentals. In the wild or on a roof they usually naturalize under favorable growing conditions by self-seeding and through bulb offsets and rhizomes. Foliage generally persists late into the summer long after flowering.

From a design aspect, their upright growth habit adds a vertical element that complements the horizontal spreading form of sedum and increases the potential for biodiversity as the flowers attract butterflies, bees, and birds. Alliums have no serious insect problems as the sulfur compounds they produce apparently help ward off insect pests. Root rot may be a problem in waterlogged growing media, but poor drainage should never be a problem on a properly designed and installed green roof. Two alliums that are useful on green roofs are *Allium cernuum* and *Allium schoenoprasum*. Both have performed admirably in studies conducted at Michigan State University.

ALLIUM CERNUUM

Allium cernuum (wild nodding onion) is native from Canada down to Mexico, and in its natural environment, it tolerates drought and shallow rocky soils which make it ideal for extensive green roofs. Nodding onion is suitable within USDA hardiness zones 4 to 8, performs best in full sun, but can benefit from some afternoon shade in warmer regions. It normally reaches a height of 30 to 45 cm (12 to 18 in). Rising above its upright, flat, grass-like leaves are the scapes with clusters of pink to white, bell-shaped flowers

that are organized into nodding clusters (umbels) that flower during the summer. The scape bends or nods down just below the flowers, a feature that distinguishes it from other alliums (thus the common name).

ALLIUM SCHOENOPRASUM

Allium schoenoprasum (chives) is native to Asia, Europe, and North America. However, it is grown all over the world as a common culinary herb. In North America, distinguishing native from introduced types is difficult as cultivated varieties have naturalized and crossed with native ecotypes. In contrast to *Allium cernuum*, chives possess thinner, hollow tubular, 15 to 30 cm tall grass-like leaves that tend to grow in dense clumps. Small bulbs are formed, but the plants also send out short rhizomes that help them spread. The purple flower umbels that bloom in April and May instead of during the summer are also held above the foliage, but are upright instead of nodding.

Culturally, chives are similar to other alliums. They are well adapted to green roofs as even during extreme drought conditions when the leaves dry up, the bulb generally survives underground and will grow again the following year. One caution is that they readily self-seed, and in some situations could become too aggressive. Manfred Köhler (University of Applied Sciences, Neubrandenburg, Germany) reported chives became the dominant species on a 30 year old roof in Berlin, especially on the north facing slope (Köhler and Poll, Ecological Engineering, 2010). On the roof of the building where my office is located, chives have slowly spread from an area where we were growing vegetables.

Besides the two alliums discussed above, there are numerous others that are suitable for green roofs. All would add to the vertical design element, are visually pleasing, and can help provide biodiversity.

Dr. Bradley Rowe has been conducting green roof research at MSU since 2000. Research topics include plant selection, growing substrates, carbon sequestration, stormwater runoff, energy conservation, and roof vegetable production.

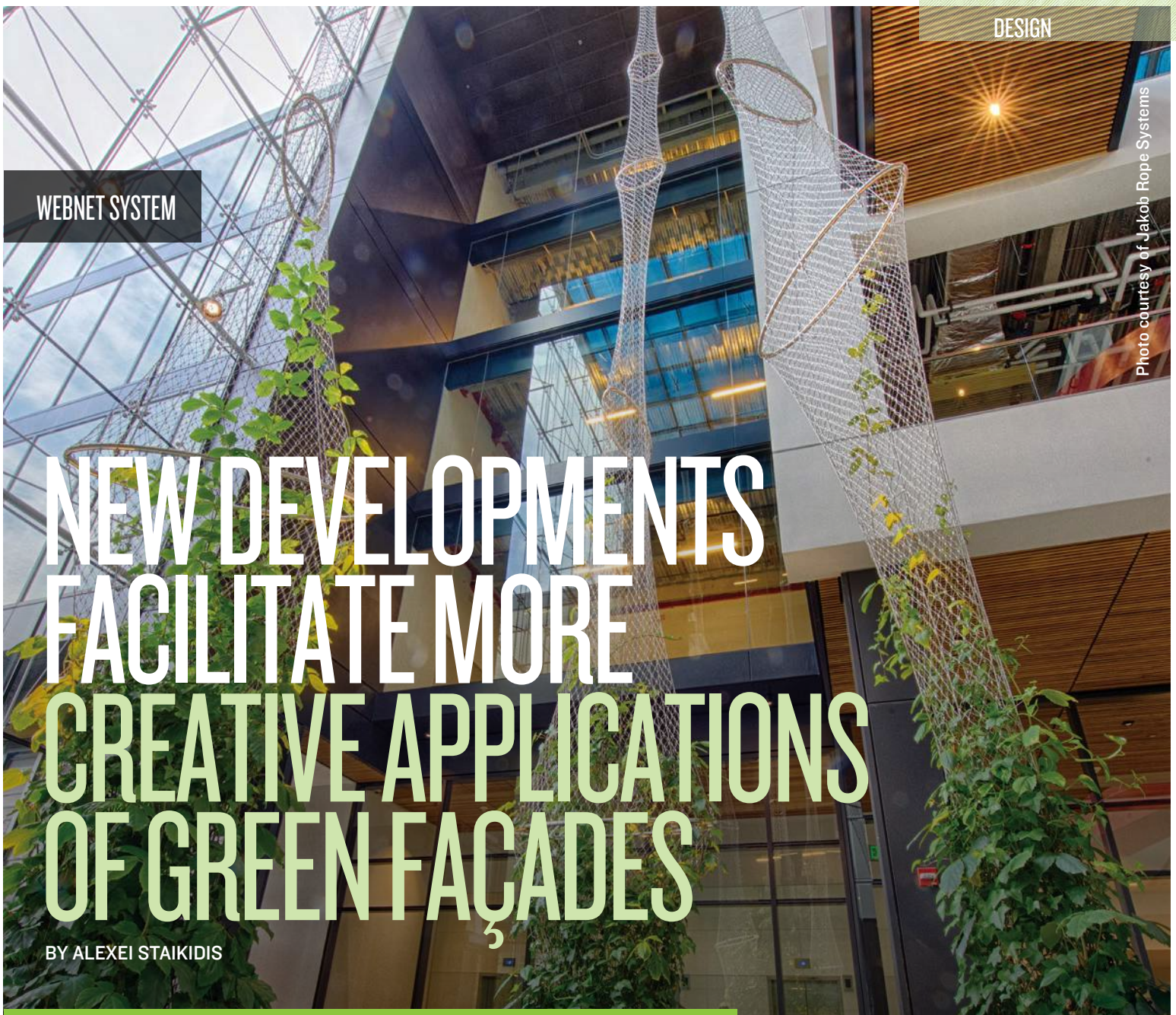


Photo courtesy of Jakob Rope Systems

WEBNET SYSTEM

NEW DEVELOPMENTS FACILITATE MORE CREATIVE APPLICATIONS OF GREEN FAÇADES

BY ALEXEI STAIKIDIS

Green façades are a type of green wall system that not only look aesthetically pleasing, but offer a multitude of additional benefits such as insulation, noise buffering, and improvements to the surrounding air quality. Buildings that incorporate a green façade can improve the look and feel of a complete district. They also enjoy added exterior protection which keep the exterior of the building from deteriorating as rapidly.

This is especially true for buildings and structures that are normally exposed to direct sunlight, in areas of extreme temperature changes or the potential for flying debris during storms. Green façade trellis systems utilize stainless steel ropes, netting and fasteners to secure climbing plants. Due to their rising popularity, and low maintenance requirements green façades can now be found in restaurants, hotels, residential properties, apartment buildings, department stores, shopping malls and hospitals.

Trellis systems offer designers many new creative options that can support a wide variety of lush plants bringing nature to both indoor and outdoor structures.

Recently, there have been advancements in trellis systems which can be affixed to the walls or ceilings of buildings or as free-standing structures.

STAINLESS STEEL NETTING - CREATE FREE-STANDING SOLUTION TO TRAIN VINES

In the past, green façades were mostly found on exterior concrete walls, but with the latest advancements, new free-standing solutions are available. Special flexible stainless steel nets made of AISI 316 cables, known as WEBNET make this possible. WEBNET offers endless design possibilities due to the flexible and strong nature of the mesh. WEBNET can be attached to stairs, fences, railings, and other structures. The netting creates the perfect environment for vine training. The flexibility of the WEBNET also allows for a free-standing look when secured on all four sides. As the vines are trained and become lush, these systems create shading for visitors.

The WEBNET features stainless steel cables that have parallel pairs which are connected through the use of sleeves or crimps. The mesh sizes and rope dimensions vary in sizes including 1.0 mm, 1.5 mm, 2.0 mm and 3.0 mm, which determines the overall look as well as functionality. Moreover, the diamond opening size can also be adjusted to meet the needs of the project and create more functionality.

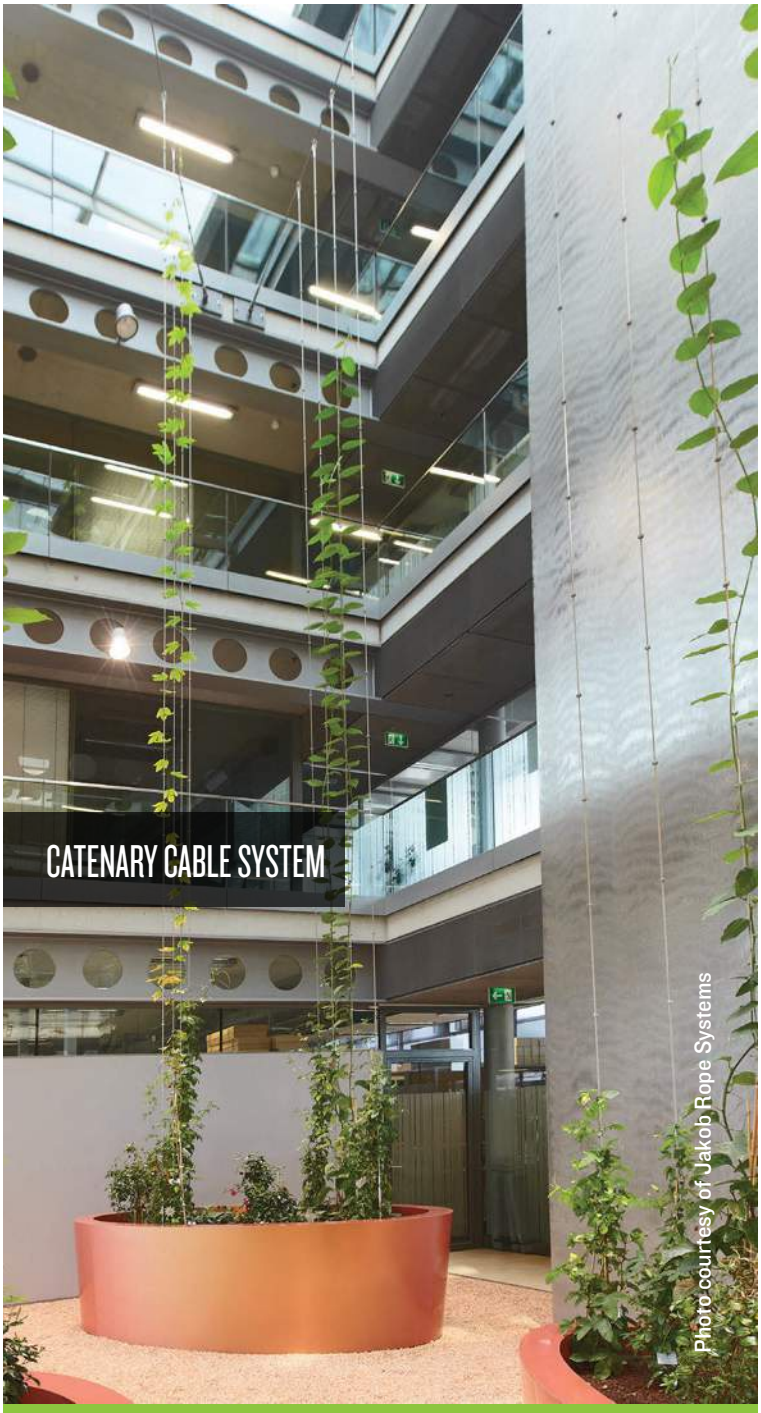
Since the WEBNET is flexible and stretches, it can be used to create a traditional flat surface or more creative structures such as three-dimensional cylinders, spheres, and funnel shapes. These shapes add a very modern touch to professional buildings and homes. Since the WEBNET is made with stainless steel AISI 316, it is perfect for both indoor and outdoor use. The WEBNET can be custom made into just about any shape or size to meet the needs of the consumer.

The cable and mesh solutions are specifically designed to blend with any architecture of a building. The mesh and cables generally become non-visible, which means that only the plants are visible. This makes for a very professionally looking living wall, regardless if it is placed indoors or outside.

CATENARY CABLE WITH VERTICAL CABLES HANGING

The Catenary cable is a new system that can be used both indoors and outdoors (see photo opposite). What makes this trellis system unique is that it doesn't require a wall or structure behind to attach it to. The Catenary cable is larger in diameter to create strength and durability. Once the main Catenary cables are installed, thinner cables are attached vertically and rods can be added horizontally to create a grid if the customer desires. Because of its stainless steel construction, the cables will last many years even in varying outdoor weather conditions.

The Catenary cable system allows for creativity in both large and small spaces. However, this system works very well indoors with buildings that have open floor plans with several stories. This allows for the vertical cables to hang and attach to the ground. Vines can then be trained on the cables to create a very unique and stunning indoor oasis.



CATENARY CABLE SYSTEM

Photo courtesy of Jakob Rope Systems

"NEW PRODUCTS ALLOW GREATER CREATIVITY AND VERSATILITY FOR DESIGNERS LOOKING TO INCORPORATE GREEN FAÇADES INTO THEIR PROJECTS."

- ALEXEI STAIKIDIS

TRADITIONAL TRAINING SYSTEMS WITH VOLUME OR 3D TRELLIS SYSTEMS

There is a lot of creativity behind the Volume or 3D training system. With the use of a variety of cables and brackets, unique patterns and offsets can be created. Besides the aesthetics that green façades create for buildings, the energy efficiency they provide is why many people choose the traditional system. The shading that green walls create for a building keeps the inside of the building warmer during the winter months and cooler during the summer time, which in turn reduces heating and cooling costs.

The Traditional or Rigid system consists of panels that are attached to an outside building wall. Typically, these are used for outside buildings due to the brackets that have to be attached to the building's exterior. These panels can be custom made to the building and to meet the needs of the consumer or the neighborhood. The latest advancements allow the panels to have unique construction for doorways and windows.

MAKING THE CHOICE

Since there are new advancements and developments in living walls, consumers must decide which system will best meet their needs. The various types of living wall installations have different price points. Most of these systems are easily installed, requiring no specialized training. New products allow greater creativity and versatility for designers looking to incorporate green façades into their projects.

Alexei Staikidis is a Technical Sales Consultant with over 10 years of experience at Jakob Rope Systems, a pioneer in various types of growing mediums for plants. The company began in 1904 manufacturing of hemp ropes for local farmers. Today, many of the Jakob innovative products for greenwalls are used in over 65 countries. jakob.com

Photo courtesy of Jakob Rope Systems

BEFORE AND AFTER GREEN INFRASTRUCTURE CHARRETTE, HARLEM.

Image courtesy of Green Infrastructure Foundation

This year, Green Roofs for Healthy Cities and its charitable arm, the Green Infrastructure Foundation (GIF) reached an agreement outlining the specific roles and activities of each organization. The Green Infrastructure Foundation's mission is to work with communities to shape healthy, resilient, and sustainable places using living green infrastructure. Funded in part through grants from the Ontario Trillium Foundation and the National Fish and Wildlife Federation, GIF has many activities planned for 2017.

GREEN INFRASTRUCTURE FOUNDATION UPDATE

greeninfrastructurefoundation.org

Green Infrastructure Charrettes bring together teams of interdisciplinary experts with local stakeholders to redesign their communities with green infrastructure. GIF combines these visuals with a customized cost-benefit analysis of these redesigns to create a compelling case for green infrastructure investment.

Geen Infrastructure Charrettes are planned in Ontario (including one at Grey to Green on May 10, 2017 in Toronto), as well as in Washington, DC, and Seattle, Washington at CitiesAlive on Sept 22, 2017.

The development of a Green Infrastructure Valuation Training Course. The benefits of green infrastructure are well known, but often difficult to value. This difficulty creates an obstacle, where green infrastructure is often not considered when making important investment and asset management decisions. The goal of this course is to help individuals, especially those in the public sector, to value the benefits provided by green infrastructure in their communities.

The continued development of the Living Architecture Performance Tool, designed to set consensus-based performance criteria and metrics for living architecture to ensure that living architecture projects will achieve desired performance benefits, so that they can be funded and incentivized by public entities with greater confidence.

The operation of the Journal of Living Architecture (JLIV), peer-reviewed journal with a mission to expand and update the research and knowledge base for living architecture and allied professions. In addition, JLIV serves as a forum for emerging and contemporary issues affecting living architecture.

JOURNAL OF LIVING ARCHITECTURE

A GREEN INFRASTRUCTURE FOUNDATION PUBLICATION

The arrival of 2017 brings change to the Journal of Living Architecture, now re-branded from JOLA to JLIV. We want to acknowledge and thank Dr. David Tilley who stepped down as co-editor in November of 2016 to pursue his own research and business. He led initiatives to increase submittals while improving the publication rates and deepening the rigor of the peer review process. Dr. Tilley will remain a member of the board and be active as a manuscript reviewer. Dr. Reid Coffman will remain as Editor-in-Charge. Joining the editorial team is Dr. Richard Sutton who has been appointed Managing Editor. In addition, we are pleased to announce that Dr. Tobias Emilsson and Dr. J. Scott MacIvor have joined as new editorial board members.

Volume 4 Number 1 Pages 1-13, 2017

KELP EXTRACT (ASCOPHYLLUM NODOSUM) CAN IMPROVE HEALTH AND DROUGHT TOLERANCE OF GREEN ROOF PLANTS

Stephanie Appleby-Jones[1], Jeremy Lundholm,[1*] Amy Heim[1], [1]Department of Biology, Saint Mary's University

ABSTRACT

The soil additive Ascophyllumnodosum (Norwegian kelp) can increase drought tolerance of plants, and promote seed germination, yet there has been no published research testing this amendment on green roofs. Liquid A. nodosum extract in two volumes and a slow release fertilizer were tested in a pot culture experiment for annuals, perennial cultivars, and three native species. Kelp extract did not improve the germination percentage of any of these species. In drought conditions both on a green roof and in the greenhouse, kelp treatments increased plant biomass relative to controls for some species only; plant health and longevity were generally improved when kelp was applied as an amendment. Soil water content was higher in kelp treated pots compared to fertilizer treated pots, and higher than controls in kelp treated pots for some species. Application of this local renewable resource to green roof plants could help to improve plant and substrate health while improving drought tolerance of plants on green roofs.

Volume 4 Number 1 Pages 14-25, 2017

LIFE CYCLE COST ANALYSIS OF EXTENSIVE GREEN ROOFS IN SWITZERLAND AND THE NETHERLANDS

Davis Kantor1, Department of Facility Management in conjunction with the Green Roof Competence Center, Zürich University of Applied Sciences, Zürich, Switzerland [This manuscript has been previously published as a Cities Alive conference paper.]

ABSTRACT

Extensive green roofs in Switzerland and the Netherlands are economically sustainable when considering the added energy savings, municipal incentives and storm water fee reductions. By combing surveys, interviews, and reviews of municipal regulations for fifteen projects the Life Cycle Cost (LCC) was calculated by discounting green roof cash flows over a 50 year time period to determine a Net Present Value (NPV). This research finds that an extensive green roof NPV in Switzerland costs 27% - 37% less than a conventional flat roof. Similarly in the Netherlands, the NPV of green roofs is determined to be 16% - 26% less than a conventional flat roof. Presented here is summary of the results and the explanation of local influences of municipal incentives.

Read more at livingarchitecturemonitor.com

Photo courtesy of Jamey Stillings

STARCHITECT ED MAZRIA ON THE 2030 CHALLENGE AND HOW DESIGNERS CAN BEAT CLIMATE CHANGE

BY STEVEN W. PECK

Born in Brooklyn, N.Y., Ed Mazria earned an architecture degree from the Pratt Institute and continued with graduate studies at the University of New Mexico. He built a successful practice in New Mexico, becoming an expert on passive solar building design and energy efficiency. During the oil embargos of the 1970s, Mazria closely examined the energy consumption of his buildings – long before any widespread understanding of climate change existed.

In the early 2000s, while reviewing research on climate change and carbon emissions for a series of workshops at his firm, Mazria noticed that all of the projections at that time did not include a Building Sector – as if, to researchers, Building Sector energy consumption and emissions did not exist. Mazria discovered that those projections were not telling the true story. (See pie chart). Our risk of irreparable environmental harm had not been mitigated between the 1970s and the early 2000s, but had metastasized – and he wanted to let architects know. Mazria founded Architecture 2030, a nonprofit research organization with a mission to rapidly transform the built environment from the major contributor of greenhouse gas (GHG) emissions to a central part of the solution to the climate and energy crises. Architecture 2030 pursues two primary objectives: the dramatic reduction in global fossil fuel consumption and GHG emissions of the built environment by changing the way cities, communities, infrastructure, and buildings, are planned, designed, and constructed and; the regional development of an adaptive, resilient built environment that can manage the impacts of climate change, preserve natural resources, and access low-cost, renewable energy resources. Here Ed Mazria reflects on his biggest accomplishments to date and provides some lessons for future designers.

You've been working as an award winning architect for many decades, what is it that made you decide to try to steer the profession in a more sustainable, climate-friendly direction? What drives you Ed?

I've worked on passive design strategies in architecture from the 1970s, both as a researcher and teacher, and then as a practicing architect in my own projects. In 1979 I wrote *The Passive Solar Energy Book*. It was clear to me early on that we were planning and designing buildings in ways that were inefficient, disconnected from the natural environment, and required too much energy to operate.

When climate change became an issue, I discovered that much of the United States' energy production was used to operate and build buildings, and was shocked to discover nearly half of all greenhouse gas (GHG) emissions are produced by the building sector. I realized then that building design professionals – architects, engineers and planners – had a great responsibility, and also a great opportunity to make a real difference. That chance to move the building sector from being one of the major contributors to greenhouse gas emissions to being a key part of the solution is what drives me and our organization Architecture 2030.

"IT WAS CLEAR TO ME EARLY ON THAT WE WERE PLANNING AND DESIGNING BUILDINGS IN WAYS THAT WERE INEFFICIENT, DISCONNECTED FROM THE NATURAL ENVIRONMENT, AND REQUIRED TOO MUCH ENERGY TO OPERATE."

- ED MAZRIA

To date, what have been your greatest accomplishments of the 2030 Challenge and associated programs?
Since 2006, the landscape for low-carbon buildings has been transformed, and designing with sustainability and high performance in mind has become the standard approach. Zero Net Carbon (ZNC) buildings have gone from being prototypes and experiments to being widely built and, in the case of California, being the standard that will be adopted for new residential buildings in 2020 and commercial buildings in 2030. Of course, this entire shift is not only due to the 2030 Challenge, but it has helped focus the industry's attention on the problem, and suggested a path to solving it.

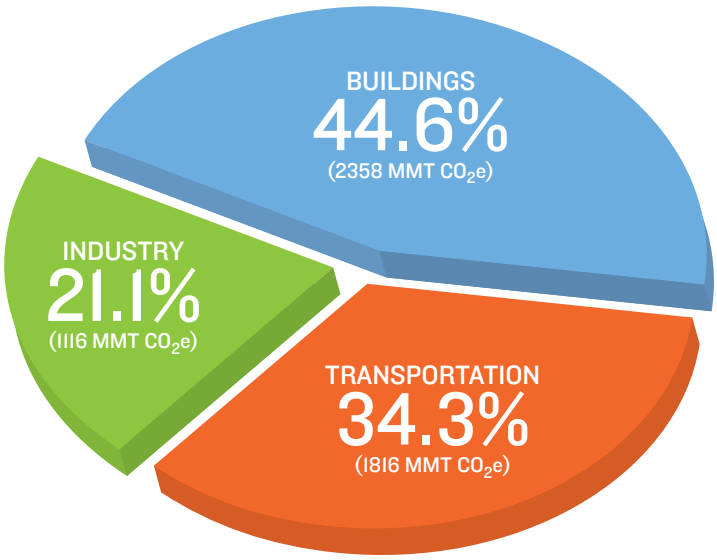
The 2030 Challenge has been adopted and is being implemented by 80 percent of the top 10 and 65 percent of the top 20 architecture/engineering/planning firms in the U.S. In addition, the AIA, ASHRAE, the U.S. Conference of Mayors, the federal government, and many other organizations and state and local governments and agencies have adopted the Challenge. In Canada, the Royal Architectural Institute of Canada, the Ontario Association of Architects and cities such as Vancouver have also adopted the Challenge targets.

The Paris Climate Agreement in 2015 set a clear target of limiting the global average temperature increase above pre-industrial levels to less than 2 degrees C, and work towards keeping it under 1.5 degrees. Architecture 2030 was instrumental in organizinga Buildings Day that took place in Paris at the talks. At Buildings Day, Architecture 2030 called for a carbon neutral building sector by 2050 – which is what we'll need to do to meet the targets set in Paris.
What do you think are the greatest challenges facing architects that want to embrace living, restorative, high performance net zero carbon buildings?
The biggest challenge for the building sector is the information gap that exists in planning and designing for a carbon neutral world; giving professionals, policymakers, developers, and builders the information and tools they need - education is key. Much of our current work revolves around education, both in the US and around the world.

We've partnered with the AIA to produce the AIA+2030 Online Series (aiaplus2030.org) that covers the techniques and approaches for design professionals to create high-performance, low-carbon buildings. We're also working with building sector organizations in China on similar education, and hope to fill the information gap for cities that have committed to dramatic emissions reductions (such as New York City, with its 80 percent emissions reduction target by 2050).

How do you see green roofs and walls fitting into the goal of Zero Net Carbon buildings? How best can they contribute to this important goal?
We're clear that low-cost/no-cost design approaches come first when designing a building before looking at technologies and adding on-site renewable energy systems. So, passive design strategies such as green roofs and walls fit into that sequence. We feature recommendations on designing green roofs in the 2030 Palette (2030palette.org) - our free online platform that delivers best practices for sustainable, low carbon and resilient planning and design across the broad spectrum of the built environment. Incentivizing proven design approaches that save energy, reduce runoff, and help mitigate the urban heat island effect, like green roofs and walls– is something we support.
Does the impact of buildings on the urban heat island figure into your programming, and if so how is this being addressed?
Designing for resilience – not just reduced emissions – is something we stress across our education and policy

U.S. CO_2 EMISSIONS BY SECTOR



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DATA SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION (2012).

work, and reducing the urban heat island effect will become more important as extreme heat events becoming more common. Advice on using green roofs, vegetative cooling, and other approaches to address urban heat islands feature in the 2030 Palette, and it's something that our other programs – the 2030 Districts – also touch on. We initiated and have overseen a network of 2030 Districts, which are now established in 15 cities across the US. These are unique private/public partnerships where property owners and managers come together with local governments, businesses, and community stakeholders to develop and implement creative strategies and metrics for achieving energy, water, and transportation emissions reductions in urban environments.

Many people are feeling despair about the future at the moment. What advice would you give them?

There are many reasons to be optimistic about our progress towards a zero carbon future. One factor is the new economic reality. Property owners and developers, as well as corporations, are increasingly seeing that building to zero net carbon standards is a wise economic choice. We have seen that high-performance buildings do not necessarily mean greater construction costs, so the market case for zero net carbon construction is already compelling and will only become more so. Remodeling older buildings that do not currently meet code can greatly reduce operating costs and increase overall valuation, so high-performance buildings need not only apply to new construction. Politically there are lots of positives too: in the US, it is the states, city and local governments, and professional organizations that have been the driving force behind significant emissions reductions in the building sector. This progress will continue regardless of whom occupies the presidency. In the next two decades, China will build about 38 percent of the world's new buildings, so China's efforts to reduce greenhouse gas emissions is also a positive development.

Any other comment or information you'd like to share?

Green infrastructure consists of both natural systems such as forests and wetlands, as well as vegetative technologies like green roofs and green walls, and the products designed to support growth such as engineered soils, cisterns and irrigation systems. Green infrastructure technologies also include bioswales, meadows, planting beds, turf and permeable pavements. All of these living green infrastructure elements create a system in your community that greatly supports quality of life.

Ed Mazira is the founder of Architecture 2030 – www.architecture2030.org.

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National Research Council of Canada Wind Test Platform.
Photo courtesy of Next Level Stormwater Management

UPDATE ON WIND STANDARDS

BY RICHARD HAYDEN, GRP, RLA, ASLA, CLARB, A.M. ASCE

Vegetated (green) roofs continue to be incorporated into an ever-increasing array of buildings across North America. The architecture and landscape architecture communities continually push the envelope on the design of vegetated roof assemblies on these buildings.

Wind is a natural force that affects every part of a building. Architects and engineers use wind data to design building façades and window assemblies to be sure that those elements are properly fastened to the building structure. Fortunately there has not been a documented incident of a vegetated roof assembly being damaged by wind to the point where it comes off the building. One reason for this is the vegetated roof industry is fortunate to have certain guidelines to aid the designers in good vegetated roof practices. ANSI/SPRI RP-14 "Wind Design Standard for Vegetative Roofing Systems" was created in a partnership between GRHC and Single Ply Roofing Industry (SPRI) to be one of those guidelines.

Up until 2015, however, there was never an actual test protocol for testing vegetated roofing assemblies. In early 2015, the Canadian Standards Association (CSA) adopted a new standard (CSA 123.24-15) entitled "Standard Test Method For Wind Resistance Of Modular Vegetated Roof Assembly". This protocol was developed at the National Research Council of Canada (NRCC) facility with a group of pre-vegetated tray and mat manufacturers and addresses the wind uplift resistance of modular roof assemblies (trays) and mats only.

In 2016, the NRCC and the Canadian Roofing Contractors' Association (CRCA) pulled together a group of commercial companies to fund and begin work on refinement of this standard so that it would also to include built-up (loose laid) vegetated roofing assemblies. This group includes: Bioroof Systems, Inc.; Hydrotech Membrane Corporation; Sedum Master, Inc.; Soprema, Inc. and ZinCo Canada, Inc.

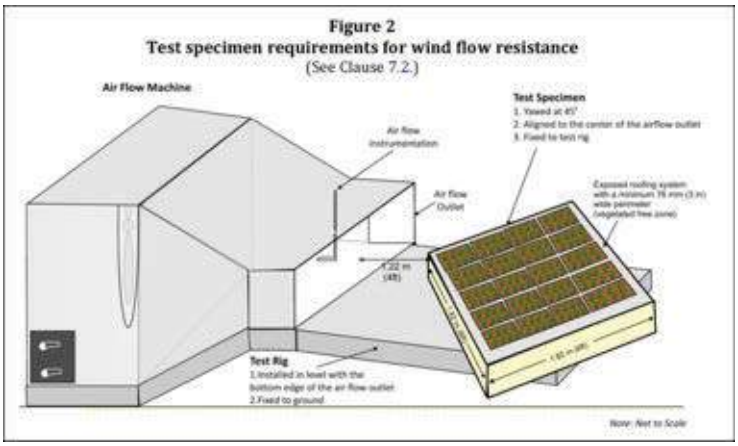
These individual companies have agreed to fund the research and testing, provide materials, and work together to develop a set of wind uplift design standards that are appropriate for built-up (loose laid) vegetated roofing assemblies. These new standards could reside in one of two places: within the existing CSA 123.24 standards or within a new, stand-alone standard. That decision will be determined as the testing protocols are developed this year.

Current Schedule: There will be two rounds of wind testing that would occur in May and August 2017. The first set of

tests will evaluate installations at Day-One. The second set of tests would be of identical assemblies that have grown in to some degree. The members of the group will be able to test their own assemblies within a range of common vegetated roof parameters. The goal of this testing is to determine any potential modes of failure such as loss of media, loss of plant material coverage, failure of any erosion control techniques, etc. In the fall of 2017 and into 2018, these results will be reviewed to determine correlations and applicability for development into a standard that would be included in a revised CSA A123.24 or a new standard.

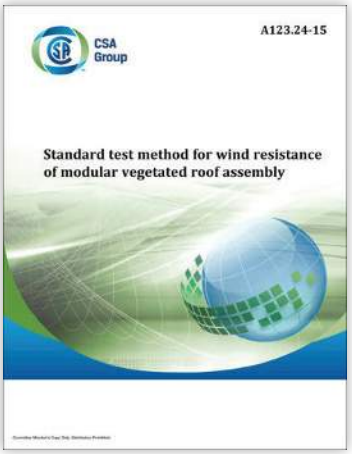
The NRC is adapting significant technologies to these testing procedures including the inclusion of load cells to measure weight changes in the test sample with a very high degree of accuracy. These very sensitive weighing devices will be placed under the test pad to measure minute differences in assembly weights before, during and after the wind testing. This data will be used in the evaluation of how the assemblies perform under the various test wind conditions.

Conceptually, the test platform will look somewhat like the image below (from the current CSA A123.24 standard). Wind will be generated in the air flow machine and funneled through the narrow air flow outlet that increases its velocity. The test sample is grown on essentially large platforms and placed in position on the test rig where it is subjected to a range of wind speeds. The goal is to develop data that can be used to determine the mode of failure at a particular wind speed.



Source: CSA 123.24

Under the agreements for all of these companies, the results of the testing cannot be published until the actual new standards are published. This is to prevent any pre-empting by individual companies from releasing data favoring their assemblies. As this activity advances, more information will be forthcoming.



(Shop.csa.ca)

Richard C. Hayden, GRP, RLA, ASLA, CLARB, A.M. ASCE, is a board member of GRHC, and the Garden Roof Department Manager, American Hydrotech, Inc.

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Photo courtesy of Steven Peck

THE EVOLUTION OF THE AWARDS OF EXCELLENCE WINNING CALIFORNIA ACADEMY OF SCIENCES

BY STEVEN W. PECK, GRP, HONORARY ASLA

In 2008, Rana Creek Living Architecture won GRHC's Extensive Institutional Awards of Excellence for the incredible 2.5 acre green roof on top of Renzo Piano's masterpiece, the LEED Platinum California Academy of Sciences in San Francisco.

The undulating green roof mimics the hills of San Francisco, and the gabion basket walkways are like the roads that cross this landscape, oblivious to the steep grades as anyone who has visited San Francisco knows. The green roof growing media is six inches deep and designed to hold more than 70 per cent of the rainwater that falls upon it. The remaining runoff is collected in cisterns and reused later for roof irrigation. The roof cools the ambient air temperature, allowing cooler air to fall into the building through one of the many circular skylights on the hills and down by the glass ceiling in the middle section.

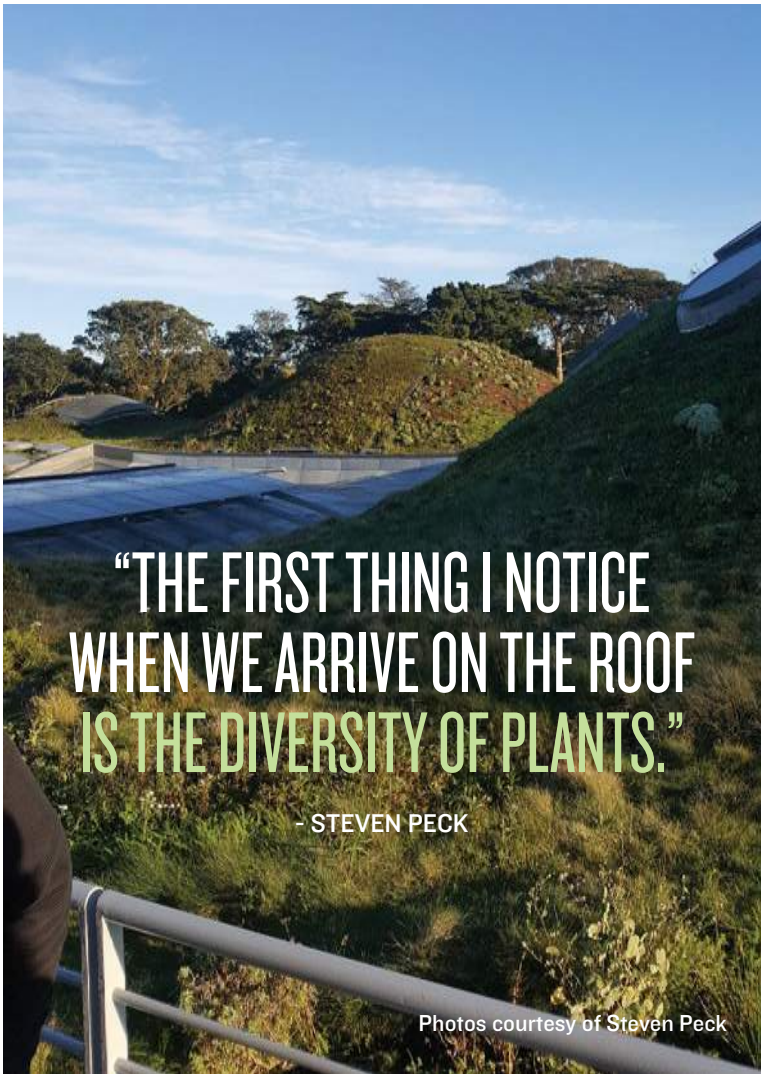
Nine species of native plants were initially planted, which provided impressive displays of color during the early years. The green roof used biodegradable, coconut coir manufactured trays, impregnated with microrrhizal fungi to facilitate their break down over time. The green roof is part of the living laboratory which is the Academy, with tens of thousands of visitors riding the elevator up to have an intimate view. So how is the roof performing, more than ten years into its life span?I had the unique opportunity to visit it alongside its designer, Paul Kephart and a number of students who were taking the Green Roof Professional (GRP) training course in the fall of 2016.

Paul shared with me his initial frustration over the limited plant pallette, "We tested dozens of species and the decision was made to severally limit them", he said. "I was quite upset until Renzo took me aside and told me not to worry, because the roof was like a canvass that the Academy would be painting for some time."

The first thing I notice when we arrive on the roof is the

GRP STUDENTS WITH PAUL KEPHART AND STEVEN PECK

CLEANING WHALE BONES



"THE FIRST THING I NOTICE WHEN WE ARRIVE ON THE ROOF IS THE DIVERSITY OF PLANTS."

- STEVEN PECK

Photos courtesy of Steven Peck

diversity of plants. As predicted by the architect Renzo Piano, the Academy has actively introduced a variety of species of plants to the roof, which now number more than 75 native species, including some rare and/or endangered species such as the California Pipe Vine which supports the California Pipe Vine Swallowtail butterfly. The Academy is hoping to providing a breeding grounds for the Pipe Vine Swallowtail. Many of these plants have also come to the roof from natural processes like seed dispersal wind and birds.

The second thing I notice is that the coconut modular trays are gone, there is no evidence of them at all, having completely biodegraded as planned. When I point this out to Paul, the inventor of this tray, he smiles the rich smile of a man that was not to be believed ten years ago. Kadee Barrett, Senior Specialty Tour Guide, shares with us the fact that the gabion basket walkways also channel the water during heavy rains to help reduce flooding. During periods of dryness, the walkways are able to condense moisture from the air, making it available to the plants. Has it leaked at all, I ask. "Not at all", replied Kadee.

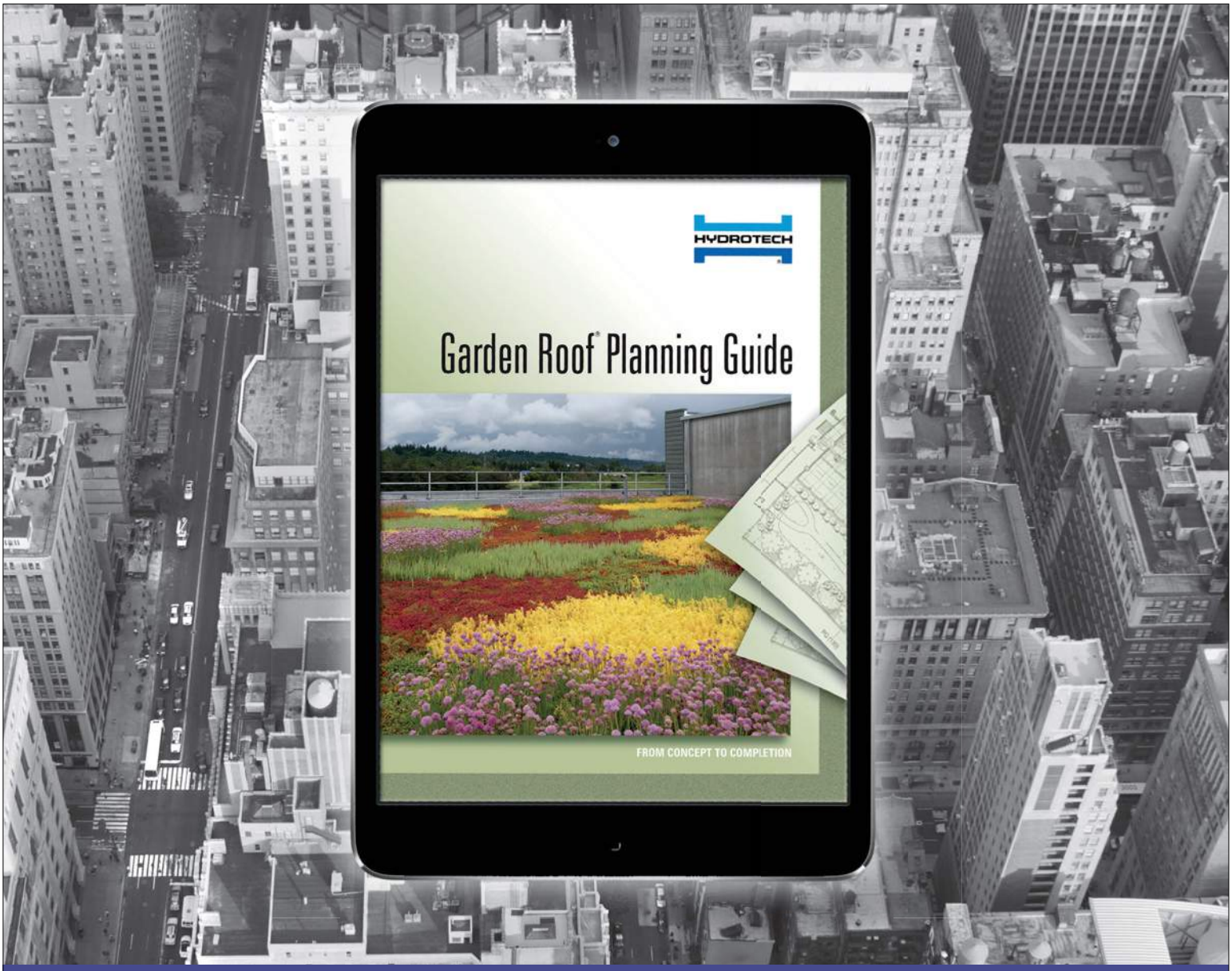
Scattered about are the bones of a whale, a most curious thing to put on one's roof. "These bones are up here so that the insects can remove the last bits of flesh, prior to their being used in displays", said Kadee. Wow! After 17 years I discover yet another benefit of green roofs, albeit a very specialized one! Over in the corner there's a box attached to the railing. This is specially designed to support cavity dwelling pollinators providing them with shelter, furthering the biodiversity potential of the roof. They have also added logs to provide additional habitat for pollinators.

The steep slopes on the sides of the undulating hills have proven to be a challenge, but the plants have organized themselves according to the various micro climates – more and less sun, more or less slope. The most delicate plants tend to grow in the middle section of the roof, which is most guarded by the surrounding hills. The Academy has a team of three full time maintenance people and a host of volunteers that do most of the weeding. Non-natives are removed and natives are allowed to remain.

As the sun slips behind the trees to the West, my California colleagues begin to shiver – "Is it cold", I ask, with a big Canadian grin! I want to stay and watch the shadows play out and then the stars emerge. But alas, we slowly move towards the elevator, all of us reluctant to leave this magical place which continues to evolve and flourish under the wise stewardship of the Academy!

FIND OUT MORE

A full plant species list is available from the Academy website: https://goo.gl/CKk5o4
Steven W. Peck, GRP with support from Emma Tamlin, BES.



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DISTRICT OF COLUMBIA'S FLEXIBLE GREEN AREA RATIO POLICY

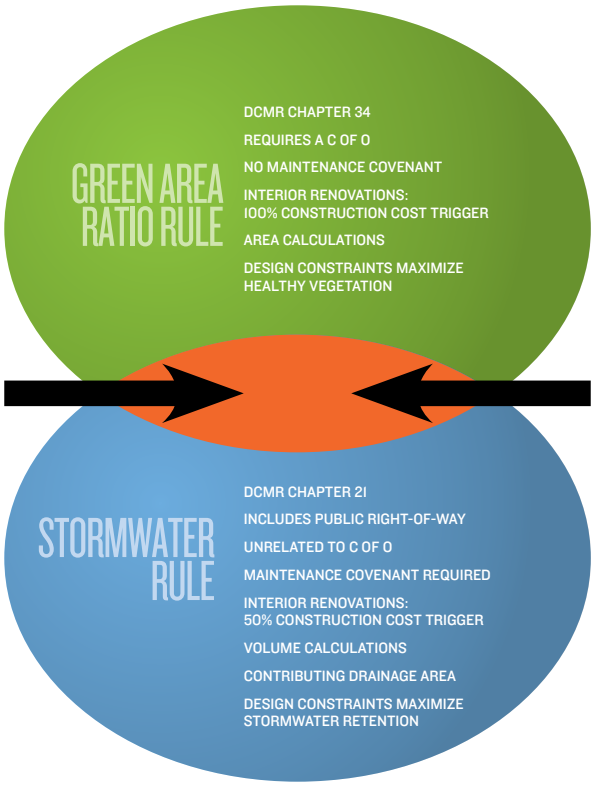
BY DR. HAMID KARIMI AND MARGIE NOONAN

The District of Columbia's Green Area Ratio (GAR) is an innovative zoning regulation that promotes the use of landscaping and sustainable practices to reduce stormwater runoff, improve air quality, reduce the city's heat island effect, and enable healthy outdoor living. New buildings that require a Certificate of Occupancy (this certificate ensures the structure/land conforms to DC's zoning regulation) must comply with GAR. Additions and interior renovations to existing buildings must comply with GAR when their cost of construction exceeds 100 percent of the assessed building value.

GAR is unique because it encourages landscape architects to be creative in designing green infrastructure at ground level and on roofs and walls. Designers choose from a menu of approved practices to achieve a score based on the project's zone. The practices may be layered on top of one another to achieve the minimum score. For example, if installing a new planting bed, the uncompacted soils receive a score based on the surface area. The groundcover vegetation on top of that receives additional points. Any shrubs and trees installed also receive points based on their size. Using native plants provides an additional bonus to encourage designers to install plants suitable to the region.

While solar panels and other sustainable energy practices are options that receive credit, GAR's primary focus is to encourage development projects to reduce stormwater runoff by planting and preserving trees and native plants and installing bioretention, permeable pavement, and green roofs and walls.

While the Office of Zoning created and regulates GAR, the Department of Energy and Environment (DOEE) provides the technical expertise to review and inspect GAR plans. DOEE is also responsible for reviewing stormwater management plans. Since GAR and stormwater plans incorporate similar practices, developers are able to address design requirements and approvals through a combined review process, which makes it easier for them to comply and save time. The following figure shows the overlap between GAR and stormwater management requirements.



EXAMPLE GREEN AREA RATIO

A 1,000 square foot development in an area with a zone of .4 needs to include 400 sq. ft. of green infrastructure.

A 500 sq. ft. intensive green roof (multiplier of .8) would meet this requirement (500 x .8 = 400 sq. ft.).

LANDSCAPE ELEMENT MULTIPLIERS

GAR LANDSCAPE ELEMENTS	MULTIPLIER
Landscaped areas with a soil depth of less than 24 inches	0.3
Landscaped areas with a soil depth of 24 inches or more	0.6
Bioretention facilities	0.4
Ground covers, or other plants less than 2 feet tall at maturity	0.2
Plants, not including grasses, at least 2 feet tall at maturity	0.3
Tree canopy for all trees, 2.5 inches to 6 inches in diameter	0.5
Tree canopy for new trees 6 inches in diameter or larger	0.6
Tree canopy for preservation of existing trees 6 inches to 24 inches in diameter	0.7
Tree canopy for preservation of existing trees 24 inches in diameter or larger	0.8
Vegetated walls, plantings on vertical element	0.6
Extensive vegetative roof over at least 2 inches but less than 8 inches of growth medium	0.6
Intensive vegetated roof over at least 8 inches of growth medium	0.8
Permeable paving over at least 6 inches and less than 2 feet of soil or gravel	0.4
Permeable paving over at least 2 feet of soil or gravel	0.5
Enhanced tree growth systems	0.4
Renewable energy generation (area of)	0.5
Water features (using at least 50% recycled water)	0.2
BONUSES	
Native plant species listed in §3403.9	0.1
Landscaping in food cultivation	0.1
Harvested stormwater irrigation	0.1

Chart and table source: Department of Energy and Environment

One benefit of a stormwater-focused GAR regulation is that it gives developers a strong incentive to create green spaces on their properties rather than meeting stormwater requirements through rainwater harvesting alone. It also causes some smaller projects that disturb less than 5,000 square feet of land to incorporate stormwater designs even though they do not trigger stormwater requirements. There are many small projects that would opt for the maximum building footprint and impervious parking area if not for GAR.

One such example of how GAR's stormwater credits influenced a landscape design is a typical row house that was converted to a multi-unit condo. The RA-1 zoned

EXAMPLE GAR TREES & SOIL

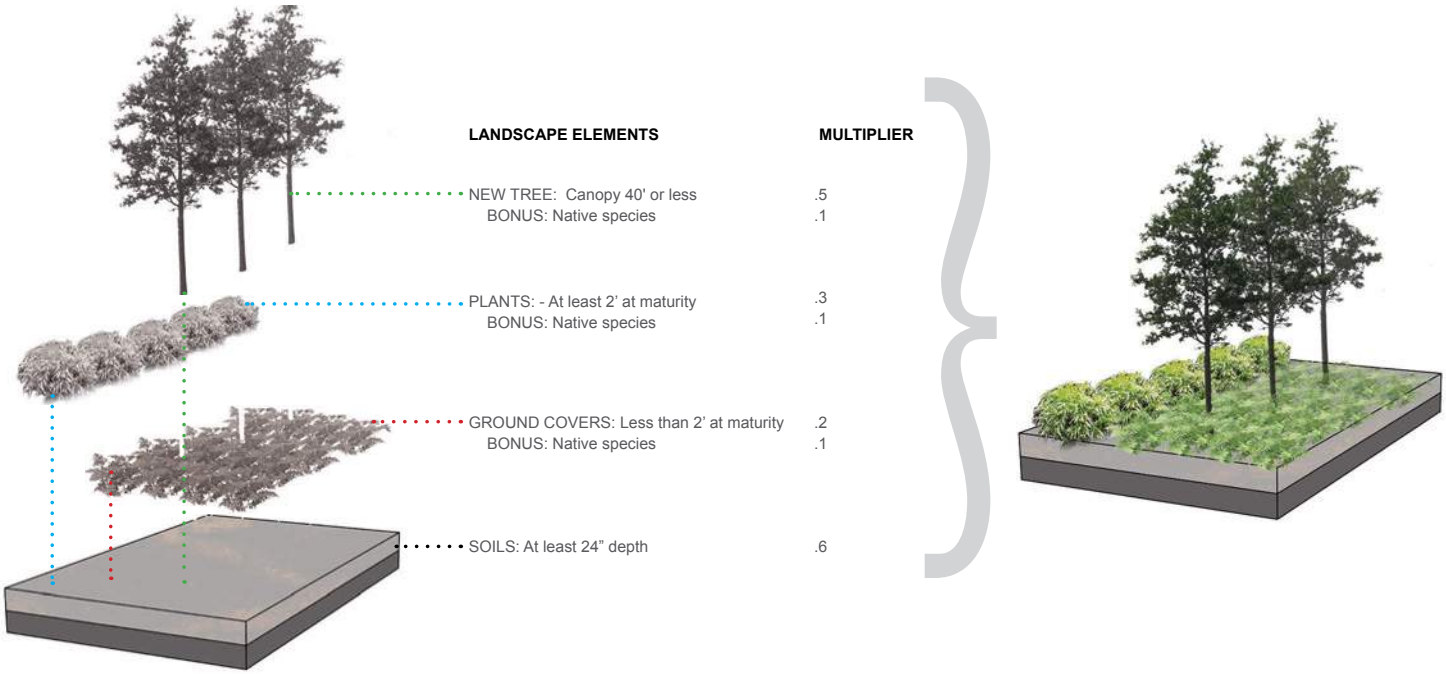


Photo courtesy of University of the District of Columbia

property had to meet a minimum GAR score of 0.4 within the 3,400-square-foot lot. The design included landscaped areas with lawn and native trees, shrubs, and groundcover, as well as the maximum allowable credited area for permeable parking spaces. (To encourage designers to install other landscape elements, permeable pavement credits cannot exceed one-third of a project's total GAR score.) Due to city parking requirements, the landscaped areas alone could not meet the GAR requirements if the parking lot was made of impervious material. The permeable pavement allowed the project to meet the GAR requirements, as well as parking and stormwater regulations, within a smaller surface area.

Since GAR was implemented in October 2013, green roofs have been the most popular option because they can be installed on buildings developed from lot line to lot line, a characteristic of ultra-urban areas. Because green roofs can also be used to meet the District's strict stormwater management requirements, they are a good fit for development and redevelopment projects in the city's dense urban core.

Surprisingly, few landscape experts have taken advantage of GAR's vegetated wall credit, which includes climbing vines and living walls with growing media. Out of 144 approved GAR plans, six planned to install a vegetated wall, while 89 incorporated green roofs. Vegetated walls are especially useful where the building footprint extends near the edge of the property, leaving little space for landscaped areas at ground level.

COMPARISON TO SIMILAR INITIATIVES

Seattle's Green Factor had the largest influence on development of the District's GAR. The majority of GAR's credits mimic the credits in the Green Factor. However, the Green Factor places more emphasis on providing publicly accessible green spaces, to the point that a project may receive credit if the landscape elements overflow into the public right-of-way. Seattle even provides a bonus credit if the landscaping is visible from the public right-of-way or other public open space. This type of credit is intended to help offset the reduction of public parks in increasingly dense urban areas overgrown with impervious surfaces. New York City has a similar incentive to encourage property owners to install Privately Owned Public Spaces. The District does not provide credits or bonuses for accessibility.

Berlin also has a progressive green area percentage requirement, which is more stringent than the District's. While the District's highest minimum GAR requirement is 40 percent, Berlin's is 60 percent. And while District properties in dense business areas may achieve as low as 10 percent landscaped area, Berlin permits no less than 30

per cent green space per property. The District's GAR provides more incentive for developers to install stormwater management practices by giving higher credit to bioretention, permeable pavement, and green roofs than to landscaped areas at ground level. Berlin, on the other hand, applies a factor of 1.0 (the highest factor possible) to landscapes with existing soil contact (not over underground structures, such as underground parking). Berlin prioritizes soil infiltration of rainwater in contrast to the District's approach to reduce stormwater runoff entering pipes during rain events.

Various strategies can be used to green cities and meet other environmental objectives. The District's GAR and stormwater regulations complement each other to reduce runoff while encouraging green approaches over gray. To meet permit requirements, many other US cities have begun adopting stormwater management regulations and incentives similar to the District's; however, few have implemented a Green Area Ratio. An important aspect of the District's strategy is its flexibility. Because GAR is not prescriptive, it provides developers a variety of options to meet the requirements. It also provides opportunity for landscape architects to contribute to the design of stormwater management practices, an area traditionally left to civil engineers. GAR projects that do not require a stormwater management plan may still install Best Management Practices (BMPs) according to DOEE's Stormwater Management Guidebook; however they do not require an engineer's signature or retention calculations.

Dr. Hamid Karimi is the Deputy Director, Natural Resources Administration, District of Columbia Department of Energy and Environment (DOEE); Margie Noonan is an Environmental Engineer at DDOE. GAR Guidebook is located on DOEE's GAR website: doee.dc.gov/GAR

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THE GROWING IMPORTANCE OF MARRYING EFFICIENT IRRIGATION DESIGN AND GREEN INFRASTRUCTURE

BY WARREN GOROWITZ

Photo Courtesy of Vegetal i.D

Regardless of your opinion on climate change, recent data released by NASA and NOAA show 2016 as the warmest year on record globally[1]. The year 2016 was also the third warmest year recorded in a row.

Water availability and stormwater management are growing issues as drought cycles and large rain events occur around the country. As the drought extremes are more pronounced, the use of potable water for irrigating landscapes, including green roofs and green walls,is often in question.When droughts become severe, landscapes are often the first to be sacrificed. The reduction of managed green spaces means much less evapotranspiration, which leads to greater heat from the sun, which leads to increasing temperatures, in a vicious cycle. We need living vegetation to help us adapt to rising temperatures in our cities and manage intense rainfall, but we also need to be cautious with and respect our water resources.

In order to address these challenges, more efficient irrigation design and comprehensive water management are required so the precise amount of water for the plant material is applied and not a drop is wasted. Large weather events cause major flooding, especially in areas where green infrastructure is lacking. Green roofs play a role in stormwater management by delaying, slowing and storing water. Efficient storage, treatment, transportation and delivery technologies are already on the market and can play a key role in supporting the use of green infrastructure, without undue strain on water resources. The capture and reuse of non-potable water in areas of great water scarcity is a strategy already being employed in drought prone areas.

Extreme heat, drought and intense rainfall - in many ways, this is the perfect storm (pun intended), and as the "original green industry" we have an opportunity and a responsibility to help mitigate these effects with green infrastructure.

THE QUESTION IS HOW DO WE RESPOND?

I see an opportunity for university led, independent research that shows benefits of green roofs and green walls specific to wise water management. As members of the green industry, we need to come together with a unified voice and back up our claims on how we can sustain, and even improve the performance of green infrastructure and how green infrastructure can actually contribute to addressing water shortage issues. We need to provide the funding for this type of research and we need to communicate the benefits of what we do every day to everyone. Now more than ever, with our cities facing weather extremes, we need to bring water management technology and expertise together with green infrastructure in order to provide solutions!

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Ewing sponsored Net Zero Water for Buildings and Sites Training Course is available online, 24/7.
See https://www.heatspring.com/app/courses/?query=net+zero+water.
Warren Gorowitz is the Vice President of Sustainability at Ewing Irrigation and Landscape Supply.
1. https://www.nasa.gov/press-release/nasa-noaa-data-show-2016-warmest-year-on-record-globally

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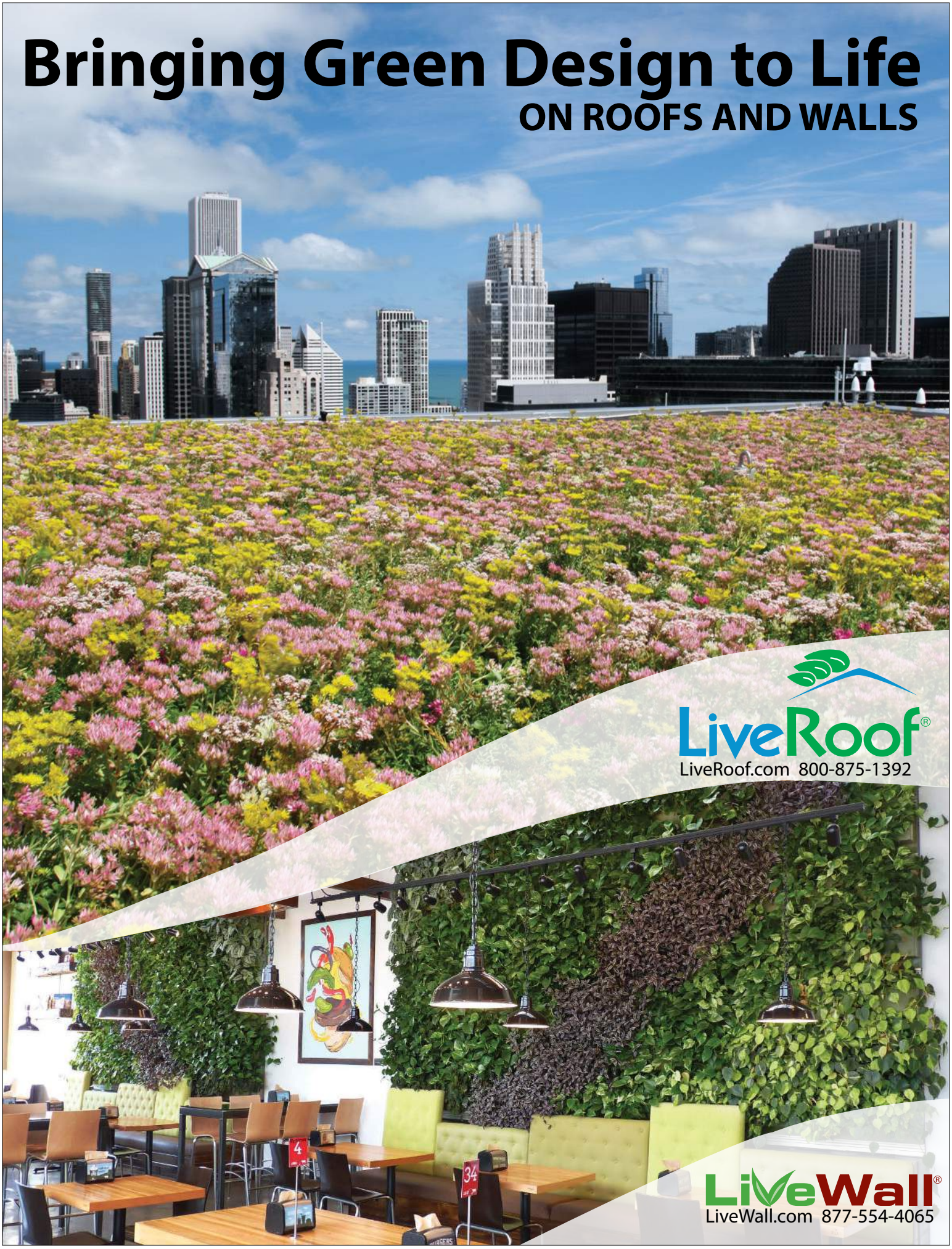

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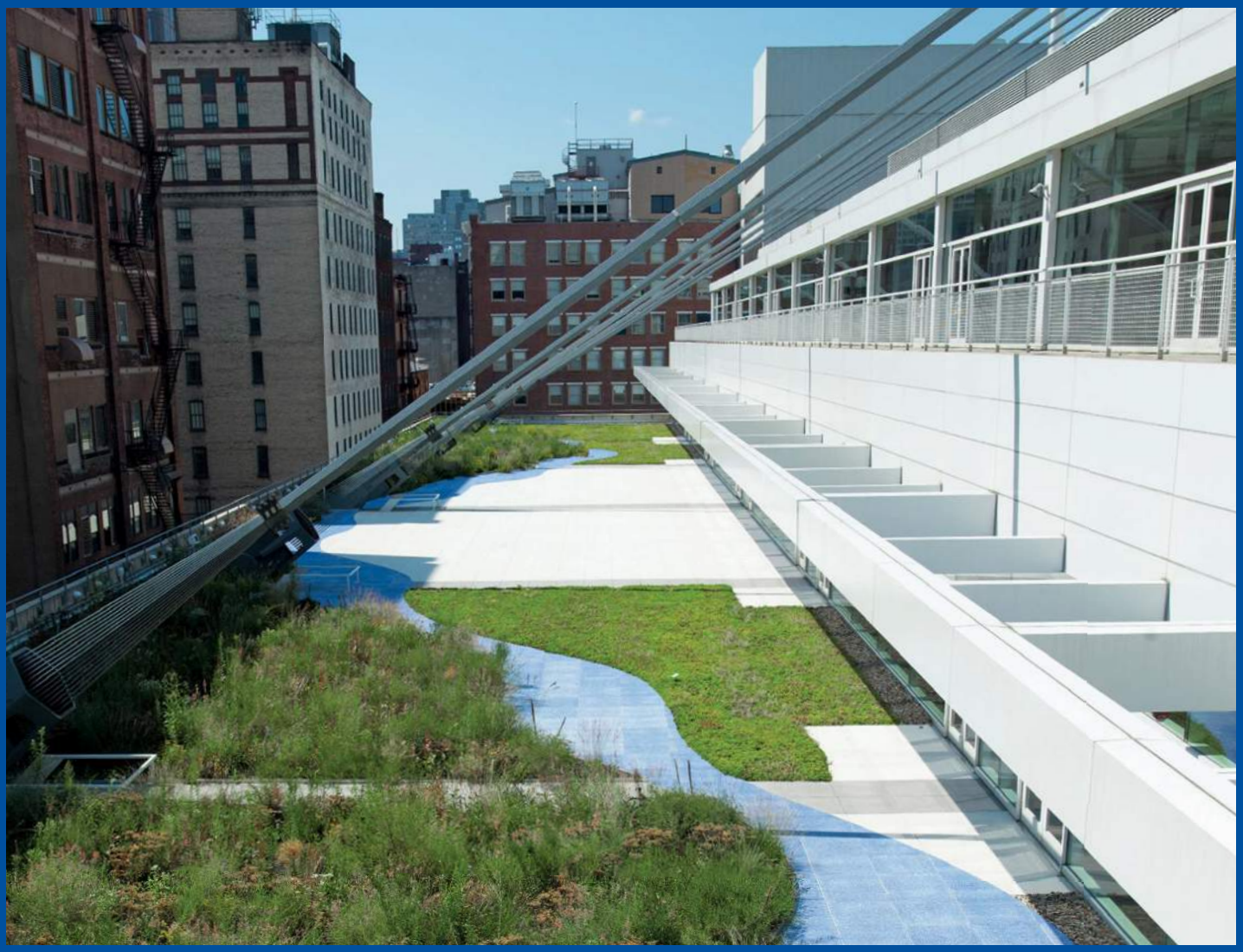

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This is the first conference to focus on using green infrastructure across the landscape with a primary goal to benefit the Great Lakes. The time is right for a comprehensive look at this important topic.

The conference is located in the middle of the Great Lakes chain, and at the forefront of many innovative green infrastructure projects. Much of Detroit is being recreated from the ground up. Green infrastructure is playing a key role. Several major cities across the U.S. and Canada are working to find ways to implement green infrastructure at a scale that offers real change. This conference will highlight many of their advancements, and the tools that can help us go yet further.

This conference will include over 130 speakers to address the topics of green infrastructure technology, economics, local government/public works, multijurisdictional/regional scale projects; and several panel discussions on important and global topics. The conference will also offer tours of green infrastructure projects across Detroit, valuable networking opportunities, and an exhibitor area. Don't miss out! Come be part of what is happening to advance green infrastructure within the Great Lakes' watershed in 2017!

Visit *www.michigan.gov/deqevents* for registration and additional information.

This event is hosted by the Michigan Department of Environmental Quality (DEQ) and its partners.