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A GREEN ROOFS FOR HEALTHY CITIES PUBLICATION

VOLUME 22 / ISSUE 1 / SPRING 2020

THE WATER & ENERGY ISSUE

INSIDE:

VOLUME 22
ISSUE 1
SPRING 2020

THE WATER & ENERGY ISSUE

INSIDE

On the cover: Energy and Water - Optigrün Solar Garden Roof at Sanoforum in Brunssum, NL. The company was looking for a roof solution with advanced stormwater retention and detention. In order to manage stormwater from around 4,600 m2 (45,000sf) the Solar Garden Roof can retain up to 2.1" of rain. The Solar Garden Roof installed includes a Smart Blue Roof that allows additional 2.5" of stormwater detention and controlled time release run-off at times when municipal infrastructure has capacity. Built in 2017. Courtesy Optigrün and Green Roof Technology

LIVING ARCHITECTURE MONITOR®

VOLUME 22 / ISSUE 1 / SPRING 2020 - THE WATER & ENERGY ISSUE

THE LIVING ARCHITECTURE MONITOR IS PUBLISHED FOUR TIMES PER YEAR IN PRINT AND DIGITAL FORMATS BY GREEN ROOFS FOR HEALTHY CITIES (GRHC)

MISSION

Green Roofs for Healthy Cities' mission is to develop and protect the market by increasing the awareness of the economic, social and environmental benefits of green roofs, green walls, and other forms of living architecture through education, advocacy, professional development and celebrations of excellence.

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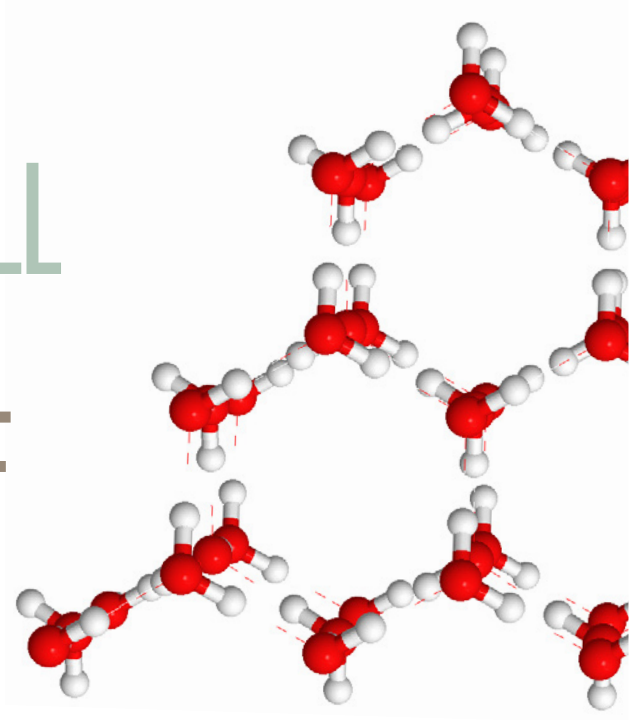
SMART GREEN CITIES WILL CAPTURE AND USE THE MAGICAL PROPERTIES OF WATER AND PLANTS



Hydrogen oxide, or water as it's commonly known, is the most abundant substance on earth and the third most abundant substance in the universe. This is one amazing molecule. It comprises 50 to 65 per cent of our body weight. The average person can only survive three days without water. Water's unique molecular structure, of two positively charged hydrogen atoms and one negatively charged oxygen atom, gives it awesome almost magical properties, properties that shape our bodies, our cities and the earth. Let's recognize some of the central roles water plays in our lives, and its incredible 'dance' with energy and plants.

Unlike most substances, when liquid water is cooled to below 4°C, it becomes less dense by forming a crystal structure that increases its volume by almost 9 per cent. Green roof professionals know they need to clear their irrigation lines before the winter, or the water inside them will expand and cause ruptures. And because frozen water is less dense than liquid water, it floats rather than sinks. That's why ice forms on the surface of lakes and rivers. If ice formed at the bottom, it would destroy aquatic ecosystems.

Our bodies use two primary processes - perspiration and respiration – involving water to regulate temperature. Perspiration allows for evaporation, which cools our bodies. Evaporation from ponds and all surfaces after a rainfall also cools our overheating cities. On some patios, micro misters above our heads perform the same function – evaporative cooling.

Strong hydrogen bonds in water result in its incredible surface tension, greater than all other substances except mercury. Surface tension is what allows water to form tiny droplets - the basis of clouds and precipitation. It also gives water high capillary action, allowing some trees to transport it 100 meters upwards to their leaves and driving stored water on green roofs and walls up to the roots of plants.

Water can store a lot of energy. Most of the elevated levels of energy caused by climate change have accumulated in the oceans, which normally moderate global temperatures. At a microscale, water stored in growing media, combined with the shading and transpiration of plants, helps redirect the sun's radiation away from buildings, rather than converting it to heat. Bradley Rowe's plant profile (pp 8-11) examines the complex tradeoffs between plants species, stormwater management and cooling.

But the magic of water doesn't stop there. Water is also a phenomenal solvent, eroding mountains and landscapes, and dissolving minerals, soluble vitamins, and nutrients for use in our bodies.

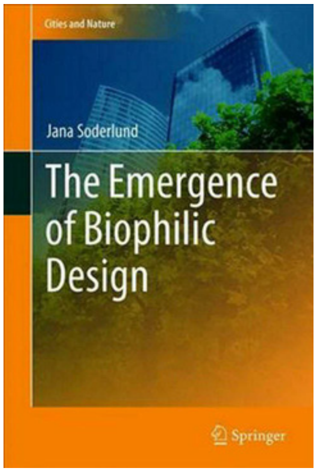
Water vapor mixes perfectly with air, with temperature and pressure regulating humidity. Plants have evolved many mechanisms to respond to varying levels of humidity and a lack of soil moisture – from jungle to desert environments. Capturing and storing rainwater for plants is key to moderating rising temperatures in many cities. Clayton Rugh's article (pp 22-25) examines how policy can maximize water retention in green roofs and cool buildings and surrounding environment.

We must significantly ramp up investment in green infrastructure in our communities in order to capture, store, use and reuse water resources. Congresswoman Velazquez's On The Roof With interview (p3) describes her proposed legislation for a multi-billion dollar Green Roof Grant Program for schools.

Water is essential to life. In 2020 and beyond, cities that fail to implement major investments and policies that protect, grow and maintain green infrastructure and thereby harness the incredible, almost magical powers of water will wither and fade. Smart green cities which embrace green infrastructure, grow and thrive.

Sincerely yours,

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



THE EMERGENCE OF BIOPHILIC DESIGN, BY JANA SODERLUND

Describes through case studies and interviews with more than twenty-five experts the emergence of biophilic design as a social movement. It provides a great introduction to the subject, the thinking of many of its leaders, case studies as well as well as an excellent summary of research on the nature-human connection. Springer, 2019.

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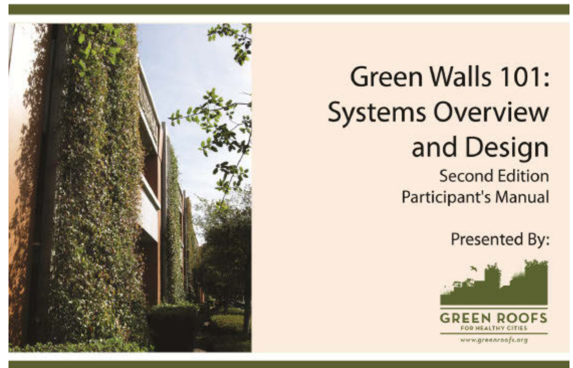
THE 2019-2020 GREEN PAGES: GREEN ROOF AND WALL DIRECTORY

A listing of all of GRHC's corporate and individual members and Green Roof Professionals, as well as award winning and Living Architecture Performance Tool certified projects.

GREENROOFS.ORG/RESOURCES



Online and on-demand for the first time ever, Green Walls 101 discusses design and construction best practices for green façades and living walls, including maintenance, irrigation requirements as well as a number of planting and site level considerations. Learn about a number of rating system options, policy drivers for living wall technologies, and research regarding performance and benefits. PRESENTED by David Yocca, AICP, FASLA, GRP, LEED AP.

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STUDENTS WELCOME!

In the interest of supporting student and young professional engagement in the rapidly growing green roof and wall industry, GRHC invites students to participate in our programs, initiatives, and events by introducing a general student membership. Students will now be able to take advantage of a discounted membership rate of only $50 USD annually to access almost all the benefits of a standard Individual Membership. Simply complete a simple application form with your expected program completion date and provide a copy of a valid student ID for verification to become a student member. The future is yours to make.
Check it out at www.greenroofs.org/student-membership

ON THE ROOF WITH... CONGRESSWOMAN NYDIA M. VELÁZQUEZ

INTERVIEW BY STEVEN W. PECK, GRP, HONORARY ASLA

Congresswoman Nydia M. Velázquez is currently serving her fourteenth term as Representative for New York's 7th Congressional District. In the 116th Congress, she is the Chairwoman of the House Small Business Committee, a senior member of the Financial Services Committee and a member of the House Committee on Natural Resources.

She has made history several times during her tenure in Congress. In 1992, she was the first Puerto Rican woman elected to the U.S. House of Representatives. In February 1998, she was named Ranking Democratic Member of the House Small Business Committee, making her the first Hispanic woman to serve as Ranking Member of a full House committee. Most recently, in 2006, she was named Chairwoman of the House Small Business Committee, making her the first Latina to chair a full Congressional committee.

Congresswoman Velázquez will soon introduce legislation in the House of Representatives entitled, the Public School Green Rooftop Program, that would direct the Department of Energy to create a Public-School Green Roof block grant to schools in states, territories and Indian tribes for green roofs on public schools. The Public School Green Rooftop Program would give priority funding to public elementary or secondary schools that serve a geographic area in which not fewer than 30 percent of students are from families with incomes below the poverty line. The proposed legislation would provide funding for a technical assessment of the potential for a green roof, its installation and four years of maintenance. The proposed legislation calls for $100 million for technical assistance, $300 million for installation and $100 million for maintenance for each of fiscal years 2021 through 2025. The legislation also recognizes the Green Roof Professional (GRP) accreditation, requiring that at least one GRP be on technical advisory team. I caught up with congresswoman Velázquez to ask her a few questions about her proposed bill, which Green Roofs for Healthy Cities has formally endorsed.

Steven W. Peck (SWP): *Congratulations on your proposed legislation Congresswoman Velázquez! The Green Roof Industry is excited about this legislation and has commented upon it and endorsed it. I was wondering what your primary motivation is for developing this legislation.*

Nydia Velázquez (NV): Thank you very much. I look forward to providing students with an outlet to learn that is simultaneously beneficial to our environment. This legislation will make a significant and positive impact on combatting climate change, while also providing students tools to solve the complex environmental challenges and make a positive contribution in their own community.

SWP: *The Program is focused on green roofs on schools, particularly schools from poorer neighborhoods! Why have you chosen this focus in the bill?*

NV: I've always felt that as we transition to a green economy, economic justice will need to be central to our strategy. This legislation fits that paradigm by focusing resources on communities that too often are left out of the conversation. Grants in this bill would alleviate the financial barriers for majority low-income schools, while also providing these students with valuable lessons. This legislation would promote the educational immersion of math, STEM, art, sustainability, green roof technology, and the benefits of a green roof.

SWP: *How does this proposal relate, if at all, to the idea of a Green New Deal?*

NV: Green infrastructure in our schools can provide water quality benefits, create wildlife habitat, and acquaint future generations with the importance of responsible stormwater management. It also improves air filtration and reduces energy costs. We must commit to sustainability and create healthy learning and living environments for our students, teachers, public education staff, and community.

SWP: *What can our readers do to support the passage of this legislation?*

NV: Everyone can ask their own Member of Congress to cosponsor and vote for this bill. The benefits are clear-- lower energy prices, cleaner air, and an environmentally friendlier community. By supporting this legislation, you are supporting a brighter future for public schools. This should be a bipartisan goal and I hope Members of Congress from both parties hear support for this legislation from their constituents.

For more information please visit: https://velazquez.house.gov/

WHY VERTICAL FORESTS ARE ON THE RISE WORLDWIDE

BY OLIVER GILLINGS-PECK

You've heard about green roofs and green walls, but have you heard of a new green trend on the condominium development scene known as vertical forests?

The Bosco Verticale project in Milan, Italy was one of the first and most widely known residential condominiums to be designed, constructed, and maintained to include a living forest on the exterior of its buildings. A vertical forest is defined as a sustainable residential building model, encompassing reforestation as key to environmental regeneration wherein a living forest is built onto the exterior of the building. At Bosco Verticale, the two beautiful stunning buildings host more than 900 trees, 5000 shrubs, and 11,000 perennials on over 96,000 sf of terraces. Such buildings have incredible appeal for the potential buyer and can sequester large amounts of Co_2 annually; however, developing and maintaining a building containing thousands of living organisms must surely have its drawbacks and challenges. Questions and concerns from both a practical and socioeconomic perspective include things like:

What are the capital and maintenance costs?

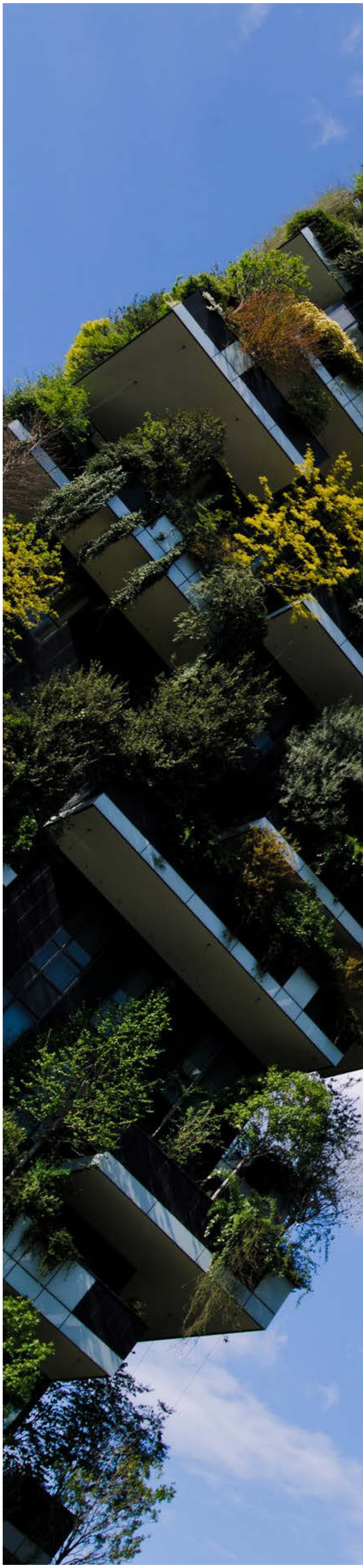
How to overcome installation and maintenance challenges?

What are the environmental benefits?

What is the public perception of vertical forests?

Not one vertical forest existed a decade ago - it was just a concept. Several major cities and firms were well underway at developing policies and designs for green roofs and walls but no single architectural firm had undertaken putting trees on buildings at quite the same scale as the concept of a vertical forest; that is not until the Stefano Boeri Architetti firm proposed the Bosco Verticale project which started construction in 2009 and finished in 2014. Being the first and only completed vertical forest, Bosco Verticale stands as an important case study for the development of other vertical forests around the world. Six years after its completion, numerous studies demonstrate that the twin forest buildings are doing well.

One of the main benefits of vertical forests is they help mitigate the urban heat island effect through shading and evapotranspiration thus reducing temperatures around the building and the surrounding area. The Bosco Verticale also absorbs 42,000 lbs of Co_2 and produces 41,800 lbs of O_2 per year. The greenery that encompasses the outside of the building acts as a natural insulator in both warming and cooling the building by 3°C.



BOSCO VERTICALE HAS BEEN AN ECOLOGICAL AND ECONOMIC SUCCESS

A study by the Council of Tall Buildings and Urban Habitat, found that the overall energy consumption reduction rate was 7.5 per cent annually, making the Bosco Verticale more energy efficient than the majority of buildings in Milan.

Vertical forests promote biodiversity. The hosting over 100 species of plants at Bosco Verticale has attracted over 1600 specimens of birds and butterflies to the tower oasis. The irrigation system, fed by groundwater, is controlled by a central monitoring system which pumps water through all of the building's floors and into the plant containers, which each have two sensors to register the substrate moisture levels.

All of these positive features sound great but what about the embodied emissions and additional costs associated with such a special building? For instance, the installation and maintenance of vegetation would assumedly require extra building materials and resources to maintain. What makes the Bosco Verticale a true flagship project is that the building design helps reduce the embodied emissions and costs. The energy consumption from the geothermal irrigation system is offset by solar powered pump systems. The additional weight of the soil in the planters is reduced by using a light aggregate mixture comprised of agricultural soil, organic matter and volcanic material. The insulation provided by the external greenery reduces heating and cooling costs/unit.

The average construction cost for the building was US$200/sf and the average selling price US$1028/sf in 2015. With an additional average maintenance cost of $6.47/sf per year the Bosco Verticale is a financially sustainable condominium. The plants are maintained using a roof-mounted crane and a basket that facilitates bi-annual pruning. Maintenance is performed by the buildings management team and the plants are not included in the ownership of the condominium unit. The individual tenants are not permitted to interfere with the maintenance of the plants, without prior authorization. COIMA, the condominium developer, pays for the maintenance of the building. In 2011, prices (in US dollars) of units ranged from $845,000 for an 861/sqft apartment to $2.6 million for a 2163/sf penthouse suite. Today not a single unit is for sale but you can rent a 1723/sf unit for $2760 a month. It is clear that the aesthetically pleasing design and the embodied environmental benefits increase the value of the units, but can the same be expected for other vertical forests being developed around the world?

Over 15 vertical forest projects are under development. Many of these are projects by Stefano Boeri Architetti. Perhaps the most ambitious of these is in Liuzhou, China. "Liuzhou Forest City" is a project, which plans to blanket an entire city with greenery totalling over 40,000 trees and 1 million plants. This level of greenery is estimated to annually sequester 10,000 tons of Co2 and 57 tons of micro-particles. Other similar projects include one by UNstudio and Cox Architecture, a two billion dollar mixed-use project dubbed "The Green Spine" in Melbourne. In Toulouse, Studio Libeskind is building a vertical forest project, called "Occitanie"; a mixed-use building including both residential units and a Hilton Hotel, slated for completion in 2022.

There are a lot of factors involved in designing a vertical forest. The plants for each building have to be chosen to include considerations such as the local climate, wind patterns, and available light. There is no one-size-fits-all design. The computer-generated images of various proposed vertical forests differ vastly in shape, size, amount of foliage, and presumably cost. Each new design has to be uniquely catered to local climate demands, making vertical forest projects unlike regular steel, glass, and concrete buildings that can be constructed anywhere. This complexity is why on any given vertical forest project, there needs to be a wide array of specialists involved in the process.

In Toronto, architect Brian Brisbane of Brisbane Brook Beynon has brought together a team of specialists including leading horticulturists, irrigation experts, academics, and forestry experts to ensure the 400-500 tree vertical forest building on Yorkville's Designers Walk will be able to survive over the long-term. According to Brisbane, "A vertical forest is really like a hillside. It's not potted plants on a decorated building. The building is really a host." Brisbane expects that his first "hillside" development will add a premium of $15,054,200 (Cdn) to the value of the 27-storey building.

It's no secret that building vertical forests involves significant development costs; however the payout for the developers lies in their ability to market them at rates higher than a regular condominium. They are a luxury. Will the public be intrigued enough to pay a premium? The answer thus far seems to be yes. The residents of the 6-year-old Bosco Verticale report they enjoy being surrounded by greenery and some have even stopped using their air conditioners because they no longer need to regulate their unit's internal temperature. These resident reports speak to the biophilia hypothesis, which posits that people have an innate tendency to seek connections with nature and other forms of life. Vertical forests represent the ultimate embodiment of urban biophilic design, because they function much like an oasis in a desert, providing people with natural green environments to escape to from the surrounding concrete jungle. Unlike public parks, vertical forests provide both a full immersion in nature, combined with prospect – the ability to see into the distance - and a place to call home.

The appeal of vertical forests is undeniable. While the number of proposed projects has sprouted up at a relatively fast pace over the past decade, there is still a long road ahead to widespread adoption. One thing is for certain; vertical forests are here to stay and for both industry professionals and buyers, they are worth a closer look.

Oliver Gillings-Peck is a researcher and freelance writer.

For More Information
Vertical Greenery: Evaluating the High-rise Vegetation of the Bosco Verticale, Milan. CTBUH research report, 2015 (Council of Tall buildings and Urban habitat)
https://www.stefanoboeriarchitetti.net/en/

PROPOSED 400 TO 500 TREE VERTICAL FOREST - DESIGNERS WALK, TORONTO

Photo courtesy BBB Architects

VERTICAL FOREST PROJECTS CURRENTLY UNDER DEVELOPMENT

DESIGNERS WALK
TORONTO, CANADA

GREEN CUBES
CAIRO, EGYPT

NANJING VERTICAL FOREST
NANJING, CHINA

LIUZHOU FOREST CITY
LIUZHOU, CHINA

BIG KING TORONTO CONDOS
TORONTO, CANADA

FORÊT BLANCHE ET LA COUR VERTE
PARIS, FRANCE

VERTICAL FOREST TIRANA
TIRANA, ALBANIA

CA' DELLE ALZAIE
TEVISO, ITALY

TRUDO VERTICAL FOREST
EINDHOVEN, NETHERLANDS

THE TOWER OF CEDARS
LAUSANNE, SWITZERLAND

WONDERWOODS
UTRECHT, NETHERLANDS

GUIZHOU MOUNTAIN FOREST HOTEL
GUIZHOU, CHINA

OCCITANIE
TOULOUSE, FRANCE

THE GREEN SPINE
MELBOURNE, AUSTRALIA

CAN STORMWATER RETENTION AND ENERGY SAVINGS BOTH BE MAXIMIZED ON ONE ROOF?

DR. BRADLEY ROWE

There is no doubt that green roofs provide numerous benefits including energy savings and improved stormwater management compared to standard roofs. In most cases, specific benefits can be maximized through plant selection.

However, can we achieve maximum energy savings and stormwater retention at the same time, or is there a trade off? Many plant related and environmental factors influence water balance on a green roof, but what we have the most control of is plant selection, substrate depth and composition, and irrigation practices that will in turn influence pre-existing moisture present before a given rain event and energy consumption.

Numerous studies have shown that vegetation type influences stormwater retention. Plant photosynthetic metabolism has a major effect on transpiration (see my 2016 discussion comparing C3, C4, and CAM plants, Living Architecture Monitor 18(1):24-29). In addition to transpiration, rainwater will be intercepted by foliage and may evaporate before reaching the substrate surface. A study in England (Nagase and Dunnett, 2012, Landscape and Urban Planning 104:356-363) reported that plant types such as forbs and grasses that possessed greater shoot and root biomass were more effective in reducing water runoff than those with less biomass such as sedum. In their experiment conducted in a greenhouse using a rainfall simulator, the approximate runoff for grass, forb, and sedum mixtures was 400 ml, 500 ml, and over 600 ml, respectively.

Related to plant species is substrate depth and composition. Deeper substrates are able to retain more water and therefore able to support plants with greater biomass with C3 and C4 plants that

DIVERSE PLANTS PROVIDE MULTIPLE ENERGY & WATER FUNCTIONS AT THE UNIVERSITY LIBRARY, BASEL, SWITZERLAND

exhibit higher transpiration rates. Changes in composition can also influence water holding capacity and capillary movement. As aerated pore space decreases, water holding capacity increases and vice versa. Planting more C3 and C4 plants such as herbaceous perennials and grasses will increase transpiration, however, there must be enough substrate moisture for these plants to survive. If moisture is not available, these species will be stressed or die. Providing deeper growing substrates or supplemental irrigation may be necessary to support C3 and C4 plants, but this practice also means that pre-existing moisture levels will be higher and the roof won't be able to hold as much water when the next rain event occurs.

Regarding energy, intuition would also tell us that deeper green roofs planted with herbaceous perennials and grasses would be better insulators and thus save more energy than shallow sedum roofs. In theory, plant species with greater biomass and higher transpiration rates should provide a greater cooling effect. This has been shown to be true in some cases. However, in other situations this assumption is not true.

MacIvor et al. (2016, Ecological Engineering 95:36-42) observed that the lowest surface temperatures (2 ºC lower) and air temperatures 15 cm above the surface (1.5 ºC lower) occurred for a sedum plant community compared to a grasses and meadow mix. Likewise, Franzaring et al. (2016, Ecological Engineering 94:503-515) reported that monocultures of *Phedi-*

mus floriferus and *Lotus corniculatus* provided better cooling than the larger erect species *Dianthus carthusianorum* and the grass *Koeleria glauca*. A viable explanation may be that the low growing spreading species shaded a greater percentage of the roof than the upright species. Shade provided by higher leaf area index will influence the overall albedo of the roof and decrease solar radiation that reaches the substrate surface.

Another thermoregulation study conducted in Ontario over a four-year period compared modules planted with sedum vs herbaceous plants and grasses (meadow). Here sedum outperformed the meadow over the total inter-annual survey period (Sookham et al., 2018, Ecological Engineering 123:10-18). During the summer, mean substrate temperatures, maximum substrate temperatures, and diurnal substrate temperature ranges were all higher for the meadow relative to sedum. During the summer, the meadow mixture maximum substrate temperature was 5.7 °C warmer compared to the sedum. Even when irrigated, the meadow was still 2.4 °C warmer, but it does show the cooling effect of irrigation. Although, this study did not measure heat flux, substrate temperature is linked to heat flux into the building which would influence energy consumption for air conditioning.

In a study conducted in Michigan where heat flux was

"AS GREEN ROOF PRACTITIONERS, THE CHOICES WE MAKE IN PLANT SELECTION, SUBSTRATE DEPTH, AND IRRIGATION PRACTICES GO A LONG WAY IN DETERMINING HOW WELL A GREEN ROOF PERFORMS."

- DR. BRAD ROWE

measured, Eksi et al., (2017, Energy and Buildings 145:174-187) reported that although the sedum roof exhibited greater extremes, the herbaceous perennial and grasses roof actually experienced more heat entering the building (or less heat leaving the building). This is an advantage during the winter months as the herbaceous roof would save on heating bills, but not in the summer when a greater amount of air conditioning would be required. The larger volume of substrate on the herbaceous roof acted as a heat sink and continued to transfer heat into the building during the evening and early morning hours during the summer.

C.Y. Jim (2014, Ecological Engineering 62:1-12) reported similar results in sub-tropical Hong Kong where summer energy consumption (energy transferred into the building) was higher for a roof covered with the herbaceous perennial, *Arachis pintoi*, relative to a roof planted with the succulent, *Sedum mexicanum*. Likewise, Franzaring et al. (2016) reported that as substrates warmed during the day, they often retained this heat to the point where night time substrate temperatures were often higher than ambient air temperatures. So contrary to conventional logic that plants with high transpiration rates are superior, during the summer months the sedum often outperforms herbaceous perennials.

So what's the best plant type to use? For stormwater, a balance must be found between providing enough water to maintain plant health and aesthetics while allowing the substrate to dry out enough to provide maximum stormwater storage capacity. In contrast, evapotransporation is a major determinant in cooling. If the substrate is dry then there is little or no transpiration or evaporation. As green roof practitioners, the choices we make in plant selection, substrate depth, and irrigation practices go a long way in determining how well a green roof performs. It's not always possible to maximize all desired benefits so the green roof design should be dictated by the primary purpose of a particular roof.

Brad 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. He was the founding co-chair of the GRHC Research Committee and received the GRHC Research Award of Excellence in 2008. Brad also teaches a course on green roofs and walls at MSU.

SPRING FOR SOME MAINTENANCE!

BY ANGIE DURHMAN

Photo courtesy American Hydrotech

No great surprise, our favorite season is here! Just as the tree canopies start budding, green roof maintenance starts when temperatures are consistently in the forties (40°F) as Sedum and other ephemerals are breaking dormancy.

There are several things to keep in mind about ramping up service. It is important to get the contracts signed ahead of your first anticipated visit. If contracted on a new installation, the site should be inspected in advance of the crew visit. I like to manage my clients' expectations by letting them know how many crew members will be working on the green roofs, and also what tools they will bring.

A "weed walk" consists of walking a grid with a visual inspection in a two foot radius. Walking in a straight line, or setting up a grid line, is essential so nothing is missed. At this time, the inspector should be mapping any troubled areas - erosion, lack of desired plants, weeds, etc. A seasoned inspector can review the notes to get a better sense of weed population over time, thus offering the ability to service that roof at key times during the growing season.

Perennial forbs on green roofs should be pruned back to allow for new growth. Last year's sedum flower stalks could be cut back, but it is usually not worth the time or budget to do so. We also keep the hardscapes clear of trash and any wandering plants that found their way into the breaks. If the timing is right, it's fun to look for the early spring bloomers such as Geum, Antennaria or Armeria.

Aside from the ecological work, spring is also a good time to set up and test irrigation (if any), perform growing media analysis, check on monitoring equipment, and make sure the drains are clear of debris. Any issues should be reported to the building staff.

As you might expect, many roofs are simply not maintained by skilled contractors. A lack of accountability is all too common in our industry. I think it is critical to work through the proper channels to find the right stakeholder who can understand that ongoing maintenance and inspections are as important as servicing HVAC. The cost of restoring failed green roofs is often higher than simply investing in regular service after installation. With the designs my firm (AD Greenroof LLC) completes, we include stewardship for the first two-five years. For remote sites, we use Greenformation®, which provides maintenance oversight to the local facility manager who might not know the crucial weed cycles. With a skilled crew and accurate documentation, there is a better chance you'll get your maintenance contract extended.

As always, follow the proper OSHA regulations and be safe on the roof!

Angie Durhman, GRP, runs AD Greenroof LLC and has been working in the green roof industry for 18 years. She is based in Minneapolis, MN.
Angie@adgreenroof.com

The Living Architecture Performance Tool Certification protocol requires a five year maintenance plan. See www.greeninfrastructurefoundation.org
Visit LivingArchitectureAcademy.com for Advanced Maintenance Course

CASE STUDY

Photo courtesy S. Peck

WATERPROOF TESTING: ONE OF THE OLDEST EXTENSIVE GREEN ROOFS IN NORTH AMERICA HAS SECRETS TO SHARE

BY ROXANNE MILLER

At the time, Mountain Equipment Co-op's (MEC) extensive green roof was considered revolutionary - installed in 1998 in Toronto, as part of its commitment to promoting new green building technologies.

Visited by thousands of people over the years, it demonstrated the early potential of green roof technology to designers, policy makers, researchers and the general public. The MEC green roof is now scheduled for demolition, along with the building, to make way for a new development. Its age provides us with a unique opportunity to test the membrane longevity claims made by the green roof industry.

In 2019 we were able to gain access to the roof and perform a cut test on two different parts of the roof. One membrane sample was protected by the green roof, while the other came from an adjacent part that remained exposed to the elements. I will take you through the methodology, as well as the results, which might finally answer that never-ending questioning: Does a green roof really prolong the life of the waterproofing?

It has been stated as a fact for many years now: green roofs double the life expectancy of the underlaying waterproofing system. When and how did this fact emerge? Where was it tested and on what type of system?

EARLY LEADERSHIP

Implementing a green roof was a bold and innovative move at the time, even for a forward-thinking organization like MEC. Marie-Anne Boivin, former product manager for Sopranature Canada, was directly involved in the project from the get-go. “The owners were actually striving to create an urban oasis in the city center”, says Mme. Boivin. “The green roof was directly correlated to the core business values of the MEC of quality, integrity, leadership, creativity and sustainability,” she added.

The whole building was designed with sustainability in mind, from spatial design as well as the choice of building materials. This green roof was not designed to be easily accessible. However, by allowing architects and engineers, amongst others, to visit the roof, it gave them chance to see something that was at the time a real novelty. It made the whole green roofing concept a palpable reality, and not just a foreign concept from Europe that was not attainable here. It helped demystified this technology and make it more mainstream, to be integrated in the early stages of design practices.

Tours of the MEC green roof helped to convince developers and policy makers in Toronto to support the passage of the Green Roof By-Law, which among other things requires green roofs on most new development projects in the city. "Having the MEC project in Toronto helped Green Roofs for Healthy Cities win support for the Green Roof Research and Demonstration Project at City Hall, and ultimately the passage of the Toronto Green Roof By-Law, which has resulted in more than 6 million square feet of projects thus far," said Steven Peck, founder and president of Green Roof for Healthy cities.

Originally, the owners of MEC where not sold on the green roof idea from the start and it took some convincing from the Soprema staff to get their approval. Marie-Anne Boivin was the driver behind the project, alongside Peter Serino, Soprema's Sales Director for Ontario. Marie-Anne went to visit the owners at the MEC head office in Vancouver in 1996 to present the project proposal and find solutions that would ultimately allow this project to go forward.

"The installation of the green roof was in itself a challenge. There was no access for a crane so all material for the 900 square meter green roof installation was carried by hand or wheel barrels," said Marie-Anne.

THE GREEN ROOF SYSTEM

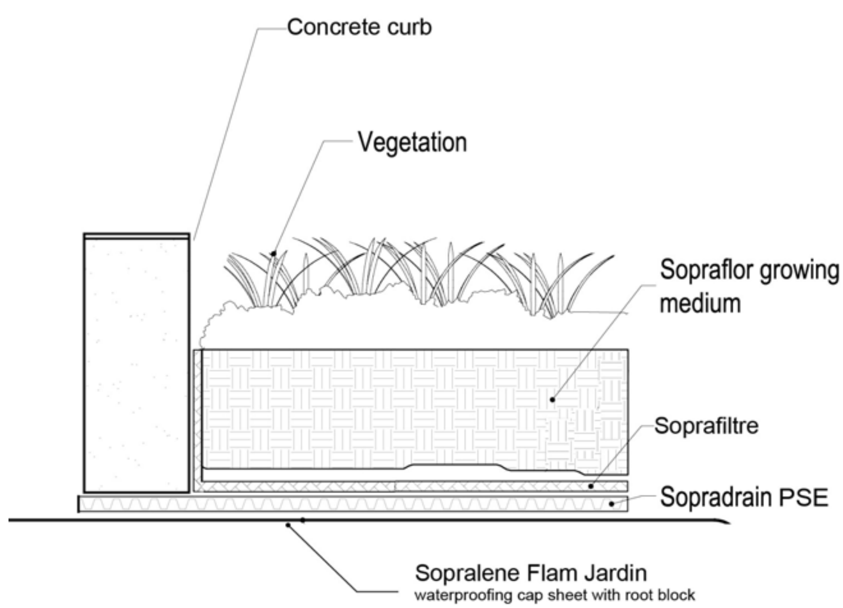
The Sopranature brand is a Soprema green roofing solution product line that originated in France over 30 years ago. The Sopranature family was introduced in Québec in 1996, at almost the same time that it came out in France. The system used in 1998 was composed a little differently then that the way they are today and this is true of the underlaying waterproofing as well. (See chart)

Soprema is first and foremost a waterproofing company. Therefore, the Sopranature green roof system was specifically designed to protect the waterproofing from all potential physical and thermal damage. Without being constantly exposed to Ultra-Violet (UV) radiation from the sun, constant heat fluctuation that causes expansion and contraction of the membrane, the waterproofing membrane's life expectancy can be drastically extended. But by how long, and in what way? These are the questions we wanted to answer with the cut test.

THE 1998 AND 2020 SOPRANATURE SYSTEMS

SOPRANATURE 1998	SOPRANATURE 2020
SOPRAFLOR X GROWING MEDIA	SOPRAFLOR X GROWING MEDIA
SOPRAFILTRE FILTER FABRIC	SOPRAFILTRE FILTER FABRIC
SOPRADRAIN PSE DRAINAGE MAT	SOPRADRAIN ECO5 DRAINAGE MAT
	SOPRABARRIER 20 ROOT BLOCK LAYER
2 PLY SBS WITH SOPRALENE FLAM JARDIN CAP SHEET ROOT BLOCK WATERPROOFING	2 PLY SBS WITH SOPRALENE FLAM 250 FR GR CAP SHEET WATERPROOFING

MEC SOPRANATURE GREEN ROOF DESIGN



PLANT EVOLUTION

The original vegetation was a mix of seeding 85 per cent and planting 15 per cent. A mix of perennials and grasses were sowed, and sedum, chives as well as iris were planted sparsely over the whole surface. An irrigation system was installed several years after the green roof was completed. There was maintenance done in the first few years, but the roof has been left unattended for many years now, with little to no maintenance on the plants. This has resulted in a wild, outgrown prairie, composed of beautiful flowering perennials and wild grasses. A partial survey of plants conducted in 2019 revealed the following species, listed in the table below.

SPRING PLANTS AT THE MEC GREEN ROOF DURING ITS FIRST YEARS IN 1999

SELECTED PLANT SPECIES IDENTIFIED ON 22 YEAR OLD EXTENSIVE GREEN ROOF

LATIN NAME	COMMON NAME
ECHINACE PARADOXA	YELLOW CONEFLOWER
PRUNUS VIRGINIANA	CHOKECHERRY
FRAGARIA X ANANASSA	STRAWBERRY
PHEDYMUS	SEDUM SP
PHLOX SUBULATE	MOSS PHLOX
ALLIUM SCHOENOPRASUM	CHIVES
GEUM TRIFLORUM	THREE FLOWERING AVENS
FESTUCA OVINA	SHEEP FESCUE
MONARDA FISTULOSA	BERGAMOT
SOLIDAGO CANADENSIS	GOLDEN ROD

SPRING PLANTS AT THE MEC GREEN ROOF IN 2019

THE WATERPROOFING TEST AND RESULTS

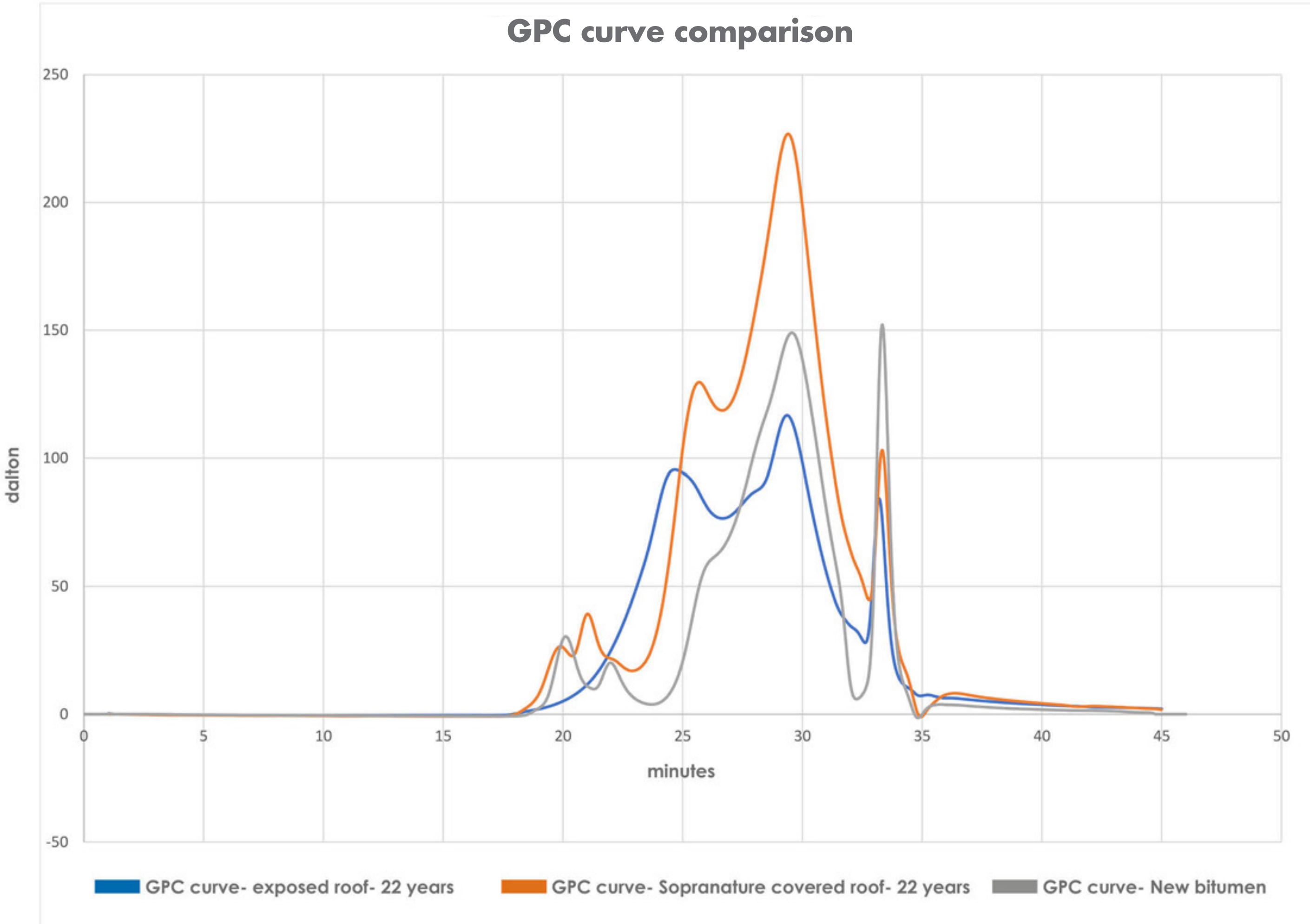
After the MEC building was sold to developers in 2018, GRHC received approval to go up on the roof and perform cut test on both the exposed surface and the green roof covered portion of the Soprema build up waterproofing. The testing of the samples was then done to assess how the bitumen and different components of the waterproofing have evolved and degraded over time.

In order to take the samples, we had to peel back the green roof and expose the underlaying waterproofing. A section of 12" x 12" was cut from the two sections, packed and sent to our testing facilities in Drummondville. Once the sample reached the lab, the bitumen was scraped off, diluted in a solvent and passed through a GPC (Gel Permeation Chromatography) testing machine. In the GPC, the smaller molecules are slowed down by the microporous material packed inside the column. A series of detectors allow to accurately determine the weight of the SBS elastomeric polymer. This evaluation allows us to measure the break down of molecular chains, in other words, how the SBS characteristics have degraded over time from long molecular chains to very small chains.

The 2 ply SBS membranes are composed of bitumen, elastomeric SBS polymers and a support reinforcement that can be composed of polyester or fiber glass. The bitumen gives the membrane it's waterproof capacity. The elastomeric polymers (SBS) will give the product its elasticity and capacity to hold a specific shape, or go back to it, like an elastic would. As for the reinforcement layer, it gives the waterproofing membrane its rigidity and resistance to puncture.

The GPC testing method is specific to SBS and bitumen. It measures the length of the polymeric chains of molecules. When exposed to aggressive environments, SBS polymeric chains are broken down, resulting in a possible loss of elasticity. The testing was done on a new SBS membrane as well as the two samples, taken from the MEC green roof (See graph). The results were then compared to a brand new SBS modified bitumen to evaluate the degradation of the SBS molecule. It is important to understand that these tests allow us to compare the degradation of the elastomeric

MEMBRANE DURABILITY ANALYSIS 22 YEAR EXPOSED, PROTECTED AND NEW



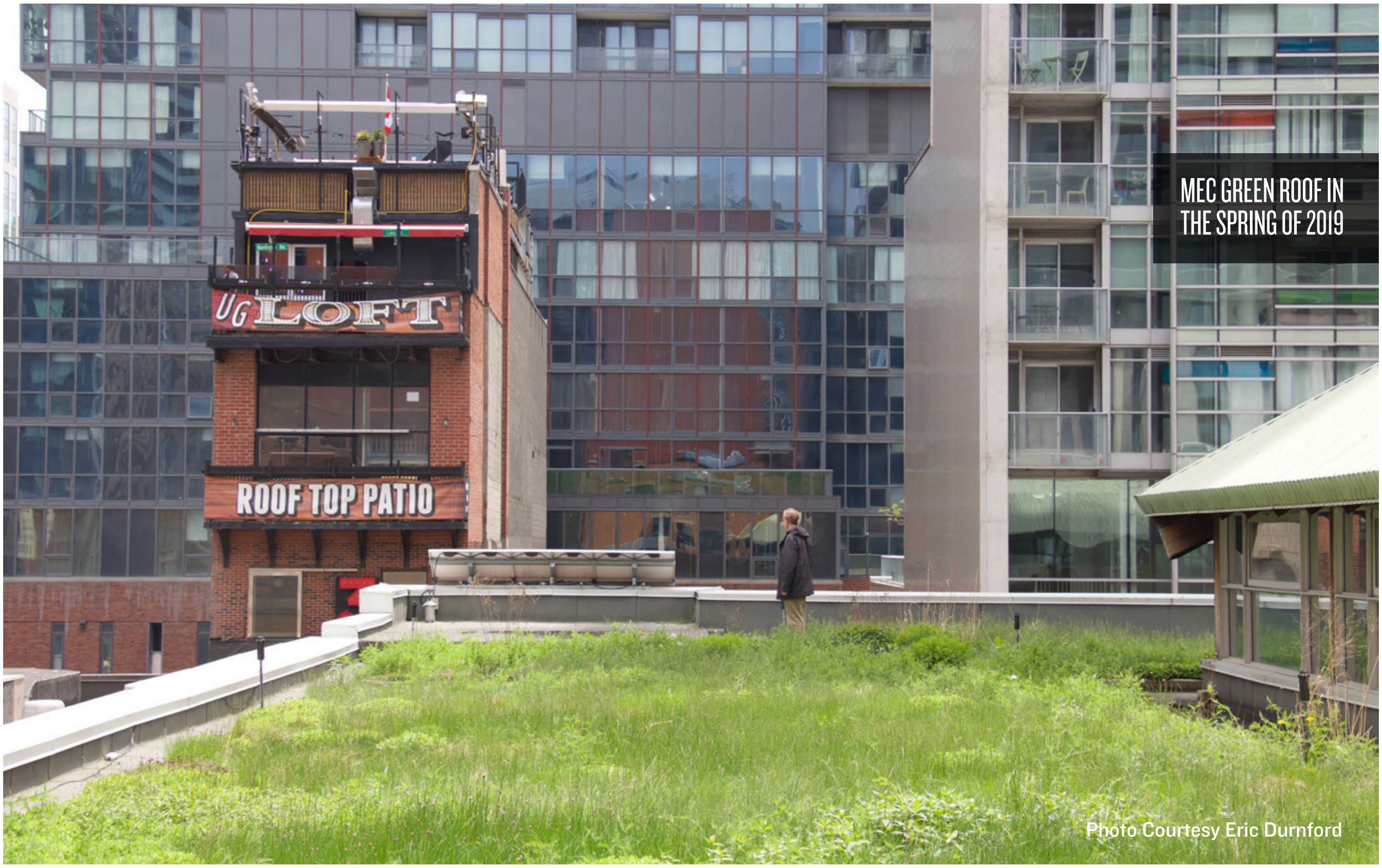
properties but do not allow to estimate if the waterproofing layer is still good, and for how long. The GPC Analysis shows how the SBS polymeric chains in the bitumen blend have been broken down by environmental conditions. That said, even if the SBS polymeric chains are getting smaller, some elastomeric properties of the material can still be present until a certain point. There is no data actually in the industry showing a "minimum elastomeric property" needed to be considered waterproof.

The grey line represents the result of the tests done on a new SBS modified bitumen. The orange line represents the sample taken under the green roof and the blue line the sample on the exposed part of the roof.

We can clearly see that new orange and grey lines follow similar curves. The firsts waves, starting at around 18 minutes are what is interesting. It gives us an indication of the degradation of the polymeric chains. What we can deduct from theses lines, is that the green roof, offering a protection against thermal differences and intense heat fluctuation, limits the degradation of the SBS polymers to the extent that they follow a similar pattern as a brand new SBS modified bitumen with its intact polymers. The test suggests that the protected waterproofing appears almost as if it were new.

The blue line however, and the disappearance of these peaks at 18 minutes, indicates that the polymers were degraded and became short enough to not be visible anymore with this test, whereas the sample coming from under the green roof clearly still shows the presence of long SBS polymeric chains. Let's state again that the short chains of the polymers do not imply that the 2 ply SBS is deteriorated and should be changed. It only means that this product would not be suitable for a new installation and that there is great variation in the length of the polymeric chain molecules.

And what about the green roof in itself? Well it is in great condition. The drainage components were still intact, the growing media showed no signs of compaction or significant loss of organic content and the root systems had not spread outside of the green roof area.



MEC GREEN ROOF IN THE SPRING OF 2019

Photo Courtesy Eric Durnford

CONCLUSION

The test results clearly show that the green roof protected the waterproofing, as the SBS in the waterproofing were almost as good as new. While it is not possible to give a precise estimate on the extended life expectancy of the waterproofing, to say that it doubles it seems to be a very timid assumption since after 22 years, the covered sample was almost exactly the same as a new SBS modified bitumen membrane. What we can take from this testing, is that a green roof does indeed protect the waterproofing and that the MEC sampling proves it. This green roof also helped pave the way for many more installations, standardizing the green roof in the building envelope design as well as helping in the adoption of the Toronto Green Roof By-Law.

The MEC green roof role in helping develop the industry, and now these sample tests from the first generation of extensive green roofs in North America demonstrate the value of this historical project, the leadership that made it happened and the waterproofing benefits of the technology. The cut test results at MEC validate the benefits of a protected waterproofing and can only add to the long list of benefits that green roofs bring to buildings, their occupants and the surrounding urban environment.

Roxanne Miller is a landscape architect and green roof specialist with Soprema Canada. rmiller@soprema.ca. Video link to cut test procedure can be found at www.livingarchitectureacademy.com

ROXANNE MILLER REMOVES GREEN ROOF LAYERS TO PERFORM MEMBRANE CUT TEST

"THE TEST SUGGESTS THAT THE PROTECTED WATERPROOFING APPEARS ALMOST AS IF IT WERE NEW."

- FRANÇOIS PAQUETTE
R&D OPERATIONS LEADER SOPREMA

MEC - GREEN ROOF
IN THE FALL OF 2019

Photos courtesy S. Peck

PROTECTED MEMBRANE
PIECE ON THE LEFT

SCORCHED: THE REAL ESTATE SECTOR BEGINS TO RESPOND TO CLIMATE CHANGE

BY JOYCE MCLEAN

As more science-based climate change projections across North America point to extreme heat as a serious public policy issue to address, many are looking to the real estate sector and their response to these very real problems.

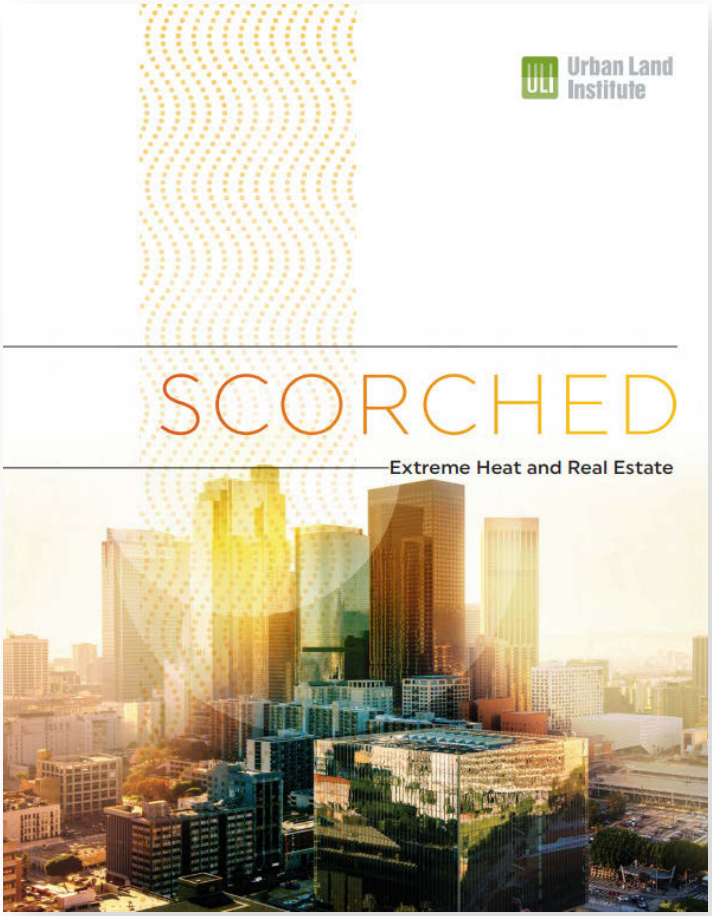
In August 2019, a comprehensive report released by the Urban Land Institute, entitled "Scorched: Extreme Heat and Real Estate" outlines both the climate change realities many American urban areas are already experiencing and suggests ways that the development sector can effectively address them and embrace change. The Urban Land Institute (ULI) is a global organization with more than 44,000 members "dedicated to responsible land use and the creation of sustainable, thriving communities".

Scorched is statistics-rich, highlighting what climate change-related extreme heat is already doing to our cities. For instance, in Los Angeles, an increase of 1.8°F above 71.6°F causes smog to increase by five per cent. The ripple effect from more smog includes serious public health impacts, including more hospital visits, more costs to the health care system and more untimely deaths, especially of our most vulnerable residents, particularly seniors and low-income people.

In Scorched the creation and mitigation of urban heat islands is discussed and green infrastructure development is emphasized as a response. Green roofs figure prominently. According to the General Services Administration, cited in the Report, green roofs can reduce urban heat islands by 30 to 40°F; and there is an approximate 6 year average payback on commercial and public buildings when extensive green roofs are installed. Other green infrastructure strategies mentioned include park and green space development, tree planting and water features.

Air-conditioning is our go-to when it's hot, but depending on the source of electricity, it is also likely to increase greenhouse gas emissions and local air pollution. When cooling demand goes sky high, equipment failures can happen. Remember 2003, when much of the US Northeast and Ontario were hit by a massive summer blackout? A cascading series of failures started when tree contact on wires occurred. ICF Consulting estimated the economic impact of the blackout at between seven and 10 billion dollars. Tree maintenance programs to eliminate tree and wire contact are essential. Many utilities, such as SMUD, Sacramento's local utility, support tree planting as a way to help cool their communities and reduce electricity demand. But if buildings were built differently, air conditioning demand might not be as high.

Scorched presents a series of North American case studies



of cities with varying climates, different existing built form and different degrees of political will. Here are some key takeaways for all who are in the business of developing or re-developing buildings. These are:

- Green infrastructure (green roofs, green walls, parks, tree planting) works to lower temperatures and create space that make people happy;
- Directing a building's waste heat to a beneficial use is critical;
- The building materials, a building's orientation to the sun, the use of shade structures, the type of HVAC, temperature and lighting systems all determine the experience in that building and its footprint;
- Cool technologies (cool roofs, walls and pavement) are complementary technologies; and
- Water features such as ponds and fountains can be effective at cooling in many cities.'

Scorched illuminates the need for the development industry and all of us, to move toward re-designing our cities to make them more people and climate-friendly, and use the gifts of nature to restore social well-being. We can all benefit from living in cooler places not only financially, but from a social, environmental and health perspective.

Joyce McLean is a freelance writer and consultant.
To download Scorched: Extreme Heat and Real Estate, please visit www.americas.uli.org

DRIVING GREEN ROOF STORMWATER MANAGEMENT THROUGH PERFORMANCE-BASED POLICIES

BY DR. CLAYTON RUGH

Government green roof policies and incentive programs have been an effective stimulus for community awareness and project development throughout the United States and Canada over the past decade.

Very few North American green roofs were built before 2000, though several notable flagship projects in the late 1990's and early 2000's – such as the Chicago and Toronto City Hall buildings, the MEC buidling and the Ford Motor Company Dearborn Rouge Plant – helped raise awareness and spur steady growth over the subsequent two decades. Since these early high visibility installations, more than thirty municipal governments have offered financial incentives and legislative mandates to encourage and require green roofs on buildings. Although green roofs provide many benefits, these policies and incentives have been adopted primarily to help address flooding and water quality impacts related to urban stormwater runoff.

Green roofs are a recognized US EPA Agency Best Management Practice (BMP) for management of urban stormwater by reducing runoff volume, peak flow, and dissolved or particulate pollutants (https://www.epa.gov/soakuptherain/soak-rain-green-roofs). In highly urbanized areas, stormwater surface runoff from impermeable surfaces – such as roofs, roadways, parking areas, and sidewalks – can overwhelm conventional stormwater systems to cause local flooding and combined sewer overflows (CSOs) from treatment facilities (in communities without separated storm and wastewater systems).

Conventional "gray" stormwater infrastructure conveys stormwater through gutters and enclosed pipes of limited capacity to temporary storage basins of various configurations before being released through some sort of control structure at a measured rate downstream, eventually daylighting to the lowest point in the system, usually a river, lake, ocean or stream. All municipal stormwater infrastructure and sewerage management systems deploy two basic strategies to store/manage stormwater runoff:

RETENTION – This generally refers to "retaining" water long-term, typically in permanent ponds, pools and other natural or constructed areas that have capacity to receive runoff and allow surplus water to evaporate , transpire and/or infiltrate into the ground over a longer period of time. At the ground level, retention storage in ponds and pools can an effective, conventional infrastructural strategy to help manage stormwater and direct overflow to recipient bodies of water as part of the system.

DETENTION – This often means "detaining" water in areas that hold runoff temporarily and are otherwise dry, single-use basins designed for this purpose. These basins can provide a finite amount of temporary flood storage but tend to be difficult to maintain and use for other purposes and often become weedy, sediment-laden, and unattractive elements in the landscape.

Green infrastructure elements, such as public parks, permeable pavement, bioswales/rain gardens and green roofs, serve as "source control" and provide elements of both detention and retention storage while optimizing the use and beauty of these facilities. In a rain garden, for example, some water (smaller rainfall events) is evaporated and transpired through the vegetation, never running off the surface, and heavier rains pond in the depression, allowing much of it to soak into the ground (retention). Only the largest volume of storm flow surcharges the rain garden and is released downstream.

The limited weight bearing capacity of most buildings as well as maintenance and water quality issues makes rooftop "lakes" impractical, so detention on green roofs is a more technically feasible and cost-effective strategy. Use of green roofs as an effective stormwater management BMP uses their sponge-like properties to soak up and delay runoff to roof drains, though some systems have longer-term detention elements as part of the integrated assembly, often referred to as blue-green roofs. While an individual green roof cannot offset all the stormwater impacts within a local watershed, each successive installation further reduces runoff volume and flow intensity that would otherwise contribute to CSO events.

Municipalities have established incentives for green roofs with government programs offering financial incentives, zoning and permitting advantages, or legislative mandates for new buildings. (https://greenroofs.org/policy-document). Incentive programs have a variety of policy criteria, such as: particular roof size class, priority sewerage district location, new or retrofit construction projects, and other possible project or BMP performance requirements. Green roof policies fall under one of two different strategies to achieve their municipal stormwater management goals:

PERFORMANCE – In performance-based policies, the complete green roof assembly must achieve a saturated water holding capacity equivalent to a target rainfall retention quantity (e.g. 1" rain event). Since the primary goal of these programs is to support stormwater treatment infrastructure function, performance-based criteria directly address this goal to offer additional advantages for broader implementation.

PRESCRIPTIVE – Prescriptive policies often state that a proposed green roof must have a stated growing medium depth (e.g. 4" media profile) to be eligible for program support or permit approval. Growing medium is often the most significant component for water storage of many green roof assemblies, so the prescriptive-based approach assumes the media layer depth serves as a proxy for the stormwater management capacity of the system.

Most green roofs are a "deep-dish pizza" of functional components: vegetation, growing medium "engineered soil", filter fabric / capillary fleece, drainage layer, and root barrier, each of which are essential for plant survival and long-term roof system performance. Of these components, the growing medium layer has the broadest range of options and most significant impact on stormwater management performance. Growing medium is a fabricated material, in that it is not made solely from raw soil materials; rather is a mix of processed and/or earthen products such as heat-expanded porous shale/clay/slate (ESCS), composted organic matter, and sand. Green roof growing media are usually coarse aggregate mixes, though may also include fabricated sheets or layers, such as horticultural mineral wool. Growing media composition and media depth should be designed to accommodate the rooting profile and physiological needs of the selected plant palette across a range of material types and functional parameters: type of aggregate mineral (i.e. manufactured heat-expanded minerals, recycled materials, or naturally-occurring earth products), aggregate particle size, type of organic matter (OM), OM material fragment size, ratio of media components (e.g. 80% aggregate: 20% OM v/v), inclusion of special admixture ingredients (e.g. clay, lime, pelletized fertilizer, etc.). Growing media vary by capillarity (= wicking), porosity (= aeration), and sorptivity (= wettability); all of which impact the material density, water holding capacity and horticultural compatibility. As these properties vary dynamically among individual green roof media components, it is recommended that incentive program applications require test-certified metrics for the water holding characteristics of each proposed medium rather than assign an assumed water content to the media layer. It is important to note that water content at greater media depths does not equal mathematic multiplication of a unit water holding capacity: i.e. six inches of media does NOT result in six times the saturated water content of 1-inch depth. This

"IT IS RECOMMENDED THAT INCENTIVE PROGRAM APPLICATIONS REQUIRE TEST-CERTIFIED METRICS FOR THE WATER HOLDING CHARACTERISTICS OF EACH PROPOSED MEDIUM RATHER THAN ASSIGN AN ASSUMED WATER CONTENT TO THE MEDIA LAYER."

- CLAYTON RUGH

GREEN ROOF SYSTEM LAYERS

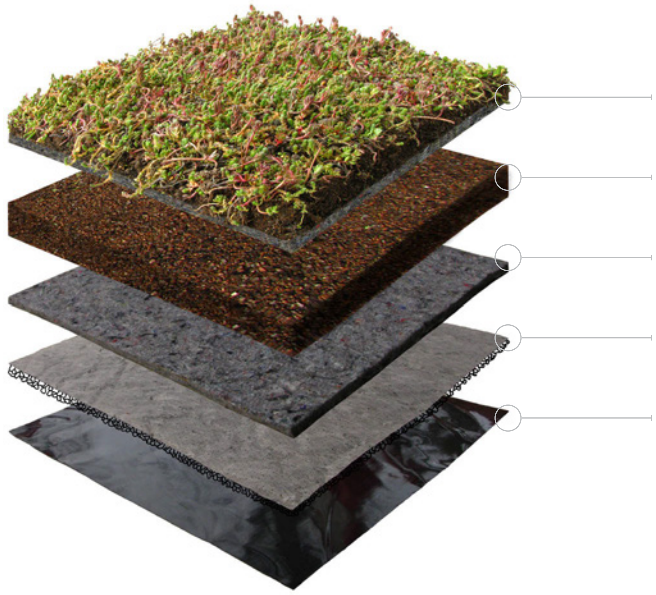


Image courtesy C Rugh

is because as the column height (= media depth) increases, the force of gravity on the water column, also called hydraulic head, leads to greater water loss at the upper levels of the media profile beginning immediately after a storm. In other words, the deeper the media profile, the drier the uppermost levels will be.

Though the growing medium layer may hold the largest fraction of stored water in the green roof assembly, virtually no green roofs achieve all their water holding capacity from media alone. Other components – e.g. drainage layer, fleece fabric, and selected plant types - contribute extended and enhanced water detention performance. Drainage layer materials can be coarse aggregates, plastic sheets with molded wells, or open-flow geocomposites with sorptive fleece fabrics. Use of a coarse aggregate drainage layer provides an additional sorptive layer; though also has a concomitant increase in overall loading weight. Molded-plastic drain sheets have built-in "cups" to collect percolated water, though lose storage capacity as cups fill with fine particulates or roots. Woven geotextiles and non-woven fleece fabrics possess water holding capacity and restrict hydraulic flow to increase media moisture content and delay runoff. Horticultural mineral wool media products possess an extremely high water-holding capacity relative to dry weight, so enhance storage and media profile moisture content. The obvious defining characteristic and most visible feature of a green roof is the vegetation, which on extensive green roofs is generally a mix of low-profile succulents, though may include virtually any local climate adapted plant species in a properly designed green roof assembly. The green roof plant community stores water in above and below ground tissues and transpires water vapor to "recharge" storage capacity between rain events. Many plants have specific rooting depth and soil moisture requirements, which influence design of growing media formulation, profile depth, and use of other component layers; each of which impacts water storage capacity, assembly load weight, and runoff characteristics.

By ignoring the complete green roof assembly, prescription-based criteria do not adequately represent the benefits of other non-aggregate or alternative media components. This may bias toward overbuilt, heavier green roofs; which not only are more expensive to initially build, but in many cases require substantially more maintenance support. Failure to consider storage-efficient, lighter weight assemblies may disqualify older or expansive buildings for more effective green roof implementation in critical urban watershed districts. The primary goal for municipal green roof policy funding should be to increase coverage with a flexible toolbox of demonstrated stormwater beneficial designs rather than a "one-depth-fits-all" approach.

On the other hand, performance-based policies focus directly on the municipal stormwater management goal by recognizing that each component of the green roof assembly helps to achieve the program goals. Unfortunately, failure to consider the entire green roof profile as part of the stormwater treatment blocks lighter weight, ecologically advantageous, lower maintenance, lower cost, and site compatible green roof designs.

Municipal green roof incentive programs have provided a critical service for urban communities and the essential stormwater treatment infrastructure their tax dollars support. Many government programs have been creative and visionary in their development and promotion of smart green infrastructure policies, including performance-based green roof criteria. Publicly funded programs should adopt the most comprehensive and versatile design requirements to fully realize the benefits of these proven technologies.

Dr. Clayton Rugh, Director, XeroFlor America. clayton@xeroflora.com
Visit LivingArchitectureAcademy.com for Green Roof and Stormwater course.

LIVING WALL ACHIEVES PUBLIC ART STATUS IN CALIFORNIA OPENING UP NEW FUNDING OPPORTUNITIES

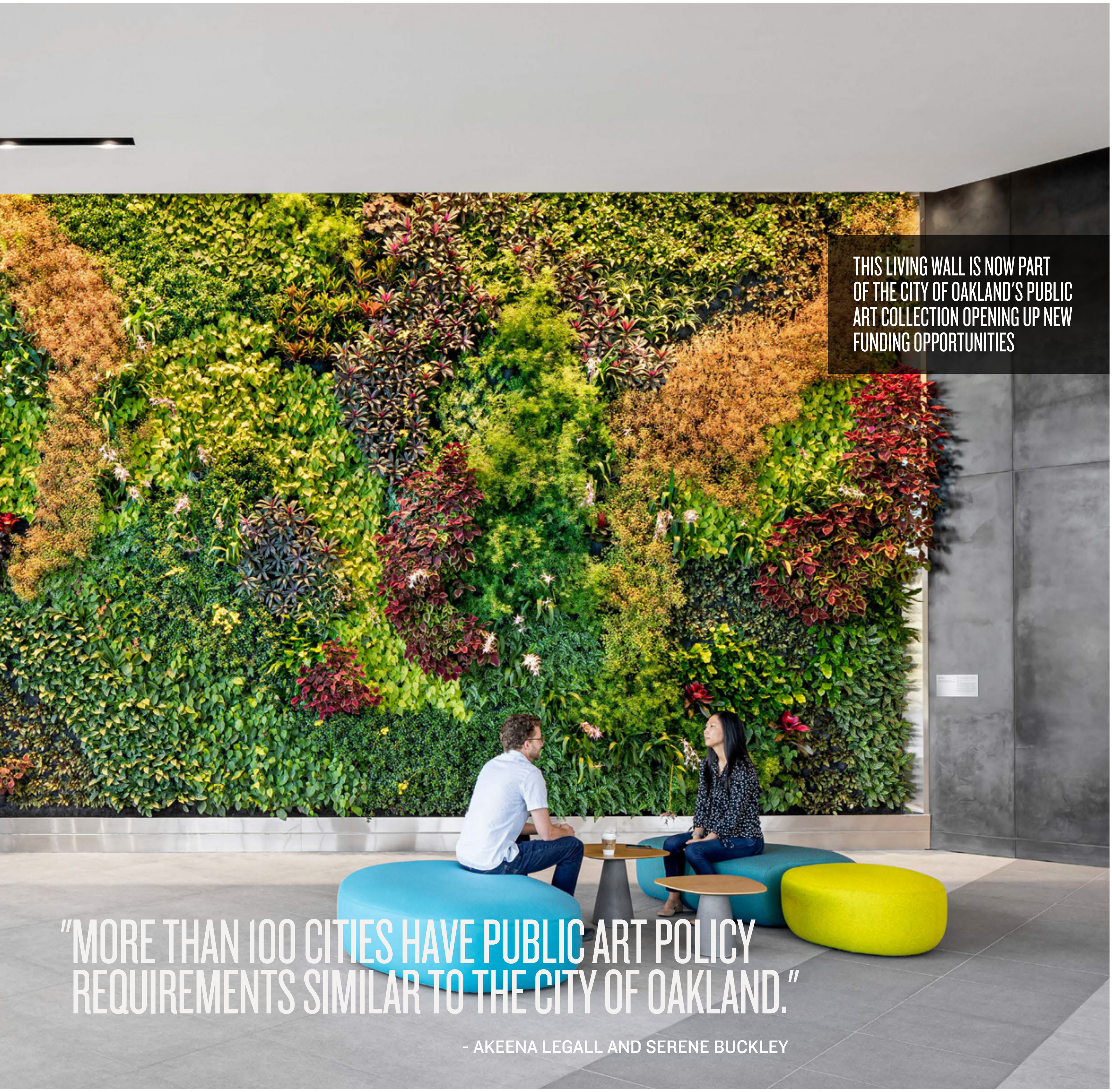
BY SERENE BUCKLEY AND AKEENA LEGALL

As we move into a new decade, architects, urban planners and civil engineers have been forced to grapple with introducing new environments that not only innovate on the principles of design, but also tackle the socio-political issues of our time, like inclusion, equity and climate change.

While U.S. cities and policies are embarking on more urban greening initiatives to address these issues in part, an increasing trend taking hold in municipalities is to invest in a more ephemeral form of civic development—the artistic and cultural economy.

In the fall of 2019, Urban Ecotones – an interior living wall installation in Oakland, California, by David Brenner, founder and principal of Habitat Horticulture – became the first living wall to meet the requirements of public art status by a US city. Traditionally thought of within the realm as green infrastructure, this new designation for living walls demarcates an innovative application for urban greening made possible by the Oakland's Public Art for Private Development requirements.

Through creative public/private partnerships and progressive thinking to capture the artistic momentum of Brenner's work for a civic stage, the 19 x 34-foot living wall is now part of the city's permanent public art collection. The stunning design features more than 25 colorful and intertwining plant species woven to reflect the interplay of Oakland's eclectic communities. Mingling tones, textures and varying depths of field form an abstract interpretation



THIS LIVING WALL IS NOW PART OF THE CITY OF OAKLAND'S PUBLIC ART COLLECTION OPENING UP NEW FUNDING OPPORTUNITIES

"MORE THAN 100 CITIES HAVE PUBLIC ART POLICY REQUIREMENTS SIMILAR TO THE CITY OF OAKLAND."

- AKEENA LEGALL AND SERENE BUCKLEY

of diversity and harmony set in a striking visual balance – a portrait of what Oakland aspires to be, painted in plants.

"Our goal for the public art program is to create unique and special places that reorient your thinking, attitude or mindset," said Kristen Zaremba, Public Art Coordinator for the City of Oakland who approved the public art proposal for Urban Ecotones. "David Brenner's body of work, his documented artistic process, and his articulation of an intent to capture the essence of Oakland in his piece met all the markings of an artist championing for inclusion in the public art discourse."

PUBLIC ART FOR PRIVATE DEVELOPMENT

According to Americans for the Arts, a nonprofit organization whose mission is to accelerate the adoption of the Arts in the United States, more than 100 cities around the U.S. have a Public Art for Private Development requirement. The aim of these policies nationwide is to integrate the work and creative thinking of artists into urban planning, design and development, and to encourage cross-industry collaborations within the private sector. Public artworks are known to bolster the profile of a city's artistic identity and are often effective drivers of the tourism economy. Additionally, residents in cities where there is a density of accessible public art report heightened feelings of content and a greater sense of belonging to their city.

While the specifics around the policy may vary from place to place, the ultimate goal is to broaden the role of artists in communities and create a sustainable funding funnel for the arts to thrive alongside rapid urban development. In order to do this, the codes typically require developers to a) either pay into a public art fund or b) provide publicly accessible art as part of the development, based on a percentage of total development costs. While cities must approve the art and artist according to their established requirements, developers have control over the selection and curation of art which must be integrated into the planning and design. Moreover, the approval of the art is generally tied into the approval of the development itself.

In 2014 the City of Oakland adopted a version of this requirement where 1 percent of non-residential private development project costs are allocated "for freely accessible public art on site, or within the public right of way."

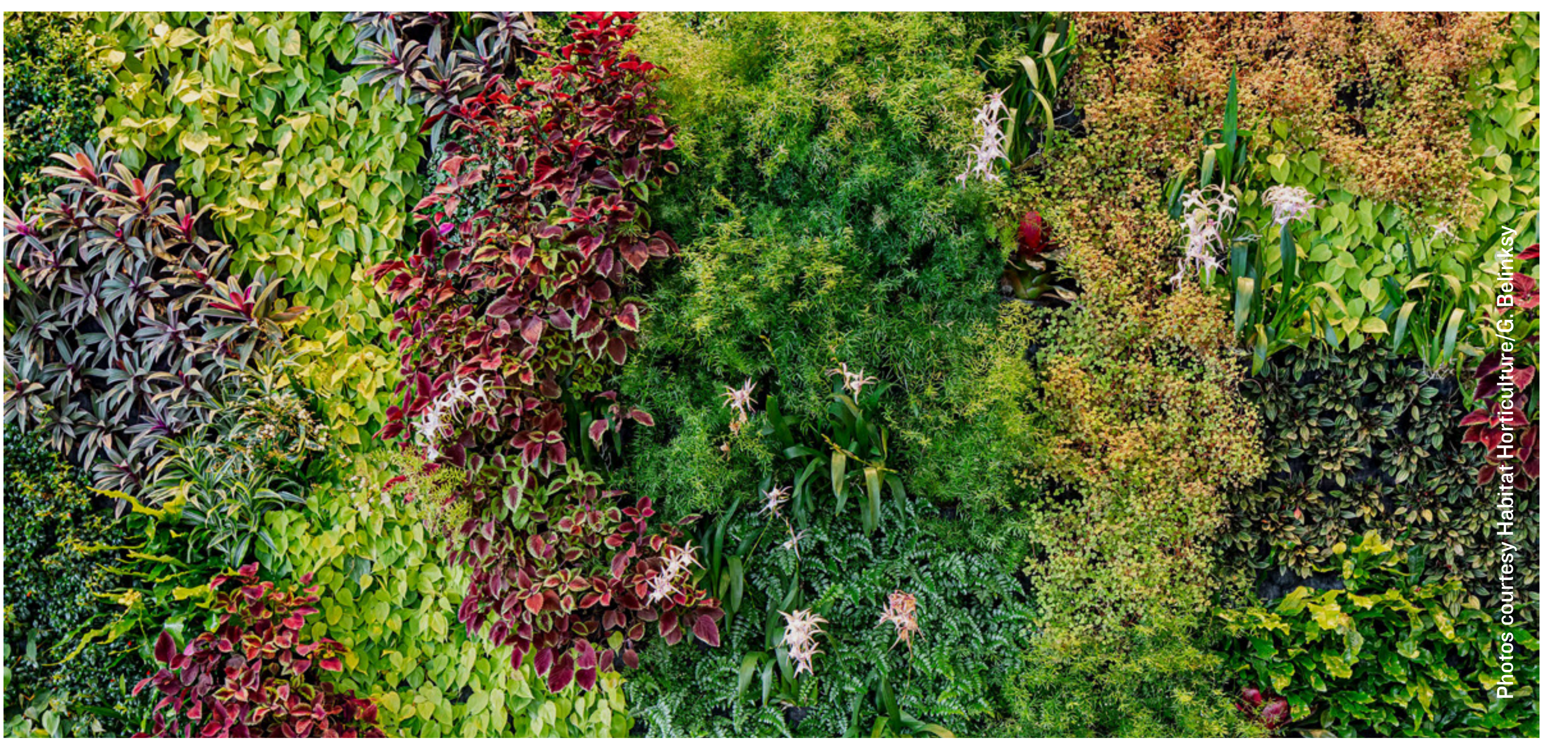
FROM LIVING ART TO LIVING INFRASTRUCTURE CONTINUUM

During the early development phases of 601 City Center – a new, 600,000 sq. ft commercial building in the heart of Oakland where Urban Ecotones now resides – project managers at Shorenstein Properties were tasked with contemplating the public art experience as integrated into the design of the new building. Not only would the selected artwork need to complement the interior architecture in both scale and aesthetics, but the selections would need to reflect a thoughtfully curated approach to meet the standards of Oakland's public art requirement.

The notion of a living wall was brought forward as an ideal addition to bring a layer of biophilia into the proposed public access lobby. David Brenner became top of mind for his notable, artistic process, large-scale capabilities and painterly designs that Habitat Horticulture is regarded for. Habitat Horticulture also uses a combination of hydroponic and soil-based systems where plants are rooted in the firm's proprietary geotextile material known as GrowTex™ made from 100 percent recycled water bottles – a major sustainability benefit for developers seeking green building certifications. Aside from the various benefits around imbuing more greenery into commercial public spaces, a public-private collaboration allows for stronger stewardship of the installation by the proposing parties versus imparting the burden of maintenance and oversight to the city. Additionally, Brenner was officially recognized as an artist by The San Francisco Museum of Modern Art for "The Living Wall" – the largest installation currently in the United States. A collaboration between Brenner and Shorenstien began as the basis of Urban Ecotones, a vision to capture a sustainable future and celebration of diversity for Oakland's public art collection.

"Being able to develop a piece that speaks to the vitality and thriving spirit Oakland was a great honor, and the public art recognition is an exciting milestone," said Brenner. "I strongly believe the role of living walls in built environments are meant to provoke, interact and engage the public in a meaningful way. This artistic recognition is a step forward in elevating the idea that nature is art, and vice versa in a way that inspires a deeper relationship to the natural world."

Akeena Legall is a freelance writer and Serene Buckley leads PR and brand communications for Habitat Horticulture.
See Urban Ecotones at 601 City Center, located at 601 12th Street in Oakland – a LEED Gold Certified building by architect Korth Sunseri Hagey and General Contractor Hathaway Dinwiddie. The lobby is open to the public Monday through Friday during regular business hours.



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DETAILS OF THE NEW YORK CITY GREEN ROOF MANDATE AND GRANT PROGRAM

BY BLAINE STAND

In 2019 we saw the passage of the Climate Mobilization Act by New York City Council, a suite of legislation to combat the existential threat of climate change, targeting the development of clean energy infrastructure, greenhouse gas reduction, and improvements to ecosystem services through the implementation of green roofs city-wide. GRHC's Technical Committee commented on several aspects of the legislation and advocated for its passage. This bill package included:

1031-A – POSTING INFORMATION ON THE INSTALLATION OF GREEN ROOF SYSTEMS

Sponsored by Council Member Rafael Espinal, this requires the office of alternative energy to post and maintain links on its website to information regarding the installation of green roofs and other resources and materials regarding green roof systems.

1032-A – REQUIRING GREEN ROOFS ON BUILDINGS

Sponsored by Council Member Rafael Espinal, this requires the inclusion of a “sustainable roofing zone” (defined as an area of a roof where a green roof, solar photovoltaic system, or a combination thereof is installed) in new construction and for buildings undergoing certain major renovations such as the replacement of an entire existing roof deck or assembly. A sustainable roofing zone is required on 100 per cent of the roof with some exceptions. A contiguous area of a sustainable roofing zone measuring less than 200 square feet must be equipped with solar photovoltaics or green roofing. Roof area with a slope less than 17 per cent that would accommodate less than 4kW of solar electricity generation must be equipped with a green roof. Some exceptions apply, dependant on site specific parameters and other building code or safety measures.

276-A – INSTALLING GREEN ROOFS ON SMALLER BUILDINGS

Sponsored by Council Member Donovan Richards, this adjusts the green roof requirements established by Int. No. 1032-A for buildings 5 stories or less, specifying a contiguous area of a sustainable roofing zone measuring less than 200 square feet, or in the case of a residential building five stories or less in height, such an area measuring less than 100 square feet, shall be equipped with at least a solar photovoltaic electricity generating system if such system would accommodate at least 4kW of solar photovoltaic electricity generating capacity. It would also require the Department of Housing Preservation and Development to study the potential impact of compliance with the green roof requirements on the affordability of certain buildings. Finally, this bill would provide for adjusting the requirements of Int. No. 1032-A for certain buildings (e.g. buildings receiving certain tax exemptions or owned by HPD) for a period of 5 years.

1252 – ESTABLISHING A PROPERTY ASSESSED CLEAN ENERGY (PACE) PROGRAM

Sponsored by Council Member Costa Constantinides, would establish a Property Assessed Clean Energy (PACE) program in the City. Authorized by state legislation, PACE is a voluntary financing mechanism that enables energy efficiency and renewable energy projects to receive long-term financing for little or no money down. Many organizations offering PACE financing are increasingly turning toward financing green roof projects as energy efficiency technologies. PACE will finance green roof design, capital and maintenance costs over a twenty year amortization period.

RESOLUTION 66 / SENATE BILL S5554B – GREEN ROOF TAX ABATEMENT RESOLUTION/AMENDMENT

Sponsored by Council Member Stephen Levin, and Senator John C. Liu, this resolution called on state legislature to consider, and ultimately extend the green roof tax abatement in the City of New York. This bill authorizes the establishment of a two-tier tax abatement structure, the continuation of the existing $5.23 per square foot abatement and the creation of an enhanced abatement of $15 per square foot for priority communities for any tax year commencing on or after July 1, 2019 and ending on or before June 30, 2024; providing that the amount of such tax abatement shall not exceed $200,000.

S5554B defines the minimum requirement for a green roof as a waterproofing membrane, a root barrier, a drainage layer, filter fabric, growing media with a minimum depth of two inches, and a vegetation layer with at least 80% coverage. The bill also stipulates that projects with a growing media profile between two and three inches, an independent water holding layer or some manner of flow control must be included unless the plants used are certified to not need regular irrigation to maintain plant health.

For the enhanced tax abatement, green roofs are required to have a minimum growing media depth of four inches and priority community zones will be determined by an as yet specified agency designated by the Mayor of New York on a rolling basis over a period of three years. Community districts will be prioritized by combined sewage overflow tributary areas that lack green space.

An added benefit of this new legislative package is the ability to supplement existing green measures such as the NYC DEP's Green Infrastructure Grant Program. This program provides private property owner applicants with funds for the design and construction of green infrastructure infiltrations which manage 1 inch of rainfall from the contributing impervious surface in priority combined sewer areas. Property eligible for the grant must have a minimum cost of $35,000, be completed within one year of construction start date unless otherwise negotiated, and recipients are subject to a 20 year covenant agreement on the property to ensure that system maintenance and performance are guaranteed. Tax abatement program expenditures are currently capped at US$1 million, a limiting factor in terms of market impact.

This package presents New York City with a new opportunity to become a sustainability leader on a municipal scale and explore new integrations of complimentary sustainable technologies to maximize their benefits, such as green roof and solar panel integrations.

Blaine Stand is the Professional Resources Manager at Green Roofs for Healthy Cities. bstand@greenroofs.org

Climate Mobilization Act: https://council.nyc.gov/data/green/
Green roof regulations: https://www1.nyc.gov/site/buildings/business/green-roofs-faq.page. DEP's Green Infrastructure Grant Program: https://www1.nyc.gov/site/dep/water/green-infrastructure-grant-program.page

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• Green Roofs and Solar Panel Synergy – April 22
• Stormwater Quality – July 2020
• Thermal Analysis – September 16
• Biodiversity and Natural Analogs – October 14

For details, and to register, visit greenroofs.org/open-forum

UPCOMING EVENTS

GREY TO GREEN: TORONTO – OCTOBER 19-20, 2020 – GREYTOGREENCONFERENCE.ORG
Chestnut Conference Center, 89 Chestnut St, Toronto, ON

CITIESALIVE: PHILADELPHIA – NOVEMBER 15-18, 2020 – CITIESALIVE.ORG
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WHY HAVE EUROPEANS EMBRACED SOLAR PANELS AND GREEN ROOFS WHILE WE ARE STUCK IN EITHER/OR MODE?

BY STEVEN W. PECK

Policies and business practices that support the best possible use of roof space are needed now, more than ever. The doctrine of "Best Possible Use" for roofs means getting the most public and private benefit from our rooftop real estate assets. Yet the rooftop solar panel market is capturing a growing portion of roof space, effectively squeezing out other uses. The problem is exacerbated when policies demand one technology, or the other. It should not be so! Solar panel green roof combinations have been implemented on hundreds of buildings across Europe. The best possible use of our roof assets is supported by the many synergies between green roof and solar panels which are ecologically, socially and economically impressive:

- Solar panels are four to 10 per cent more efficient at producing electricity when placed above extensive green roofs. The green roof keeps them cooler due to evapotranspiration and shading. For every 1°C above 25°C, solar panels lose 0.5 per cent energy output. The temperature on green roofs stays below 35°C, keeping the surrounding air temperatures and solar panels cooler.
- Green roofs help keep foreign particles off solar panels, helping them become more efficient and reducing maintenance costs.
- The plants and growing media provide the ballast required to anchor the racking system that secures the solar panels, thereby eliminating the need for heavy point loads of concrete ballast or worse, roof penetrations that are prime spots for future leaks. Since the green roof extends the life span of waterproofing, it can reduce or eliminate the need for a costly waterproofing roof replacement that would disrupt energy production.
- Solar panel green roof projects can create micro climates under the panels, which in turn create micro habitats that increase plant and insect diversity.

Millions of square feet of combined solar/green roofs have been implemented in Europe but North America still seems to be stuck in an either/or mindset. "The lack of implementation may be because the awareness isn't in the market yet," said Michael Krause, of Kandiyo Consulting, a solar industry consultant in Minnesota. "Solar panel green roof projects are more prevalent in countries like Germany, Switzerland, Austria and the UK, primarily due to good policy on green roofs and renewables," said Dusty Gedge, President of the European Green Roof Association. "Professionals are more aware that integrating the two approaches is achievable because of good systems developed by leading green roof companies," he added. Big companies like Optigrun, Bauder and Zinco have had proven systems for more than a decade. Jorg Bruening of Green Roof Technology has developed solar panel green roof projects in North America since 2008. "Some solar panel companies don't like green roofs because it means they can't sell quite as many panels. We also need more data to prove the benefits," he added.

San Francisco's Better Roof Ordinance recognizes combined solar panel green roofs in its compliance requirements (30 per cent green roof area, or 15 per cent solar panels, or a combination). A roof with 15 per cent green roof area, half covered in solar panels would meet the full requirement, leaving the remaining roof area for other purposes, such as amenity decks, rooftop farming, or sky lights.

Integrating solar panels and green roofs makes greater use of our roof assets than just solar panels, and the efficiency gains often pay for the green roof assembly. Smart designers and policy makers should embrace the integration of these technologies and maximize the benefits of their roof assets.

Steven W. Peck, GRP, Honorary ASLA is the founder and president of Green Roofs for Healthy Cities. Register for our free webinar on solar panel and green roof synergy April 22.


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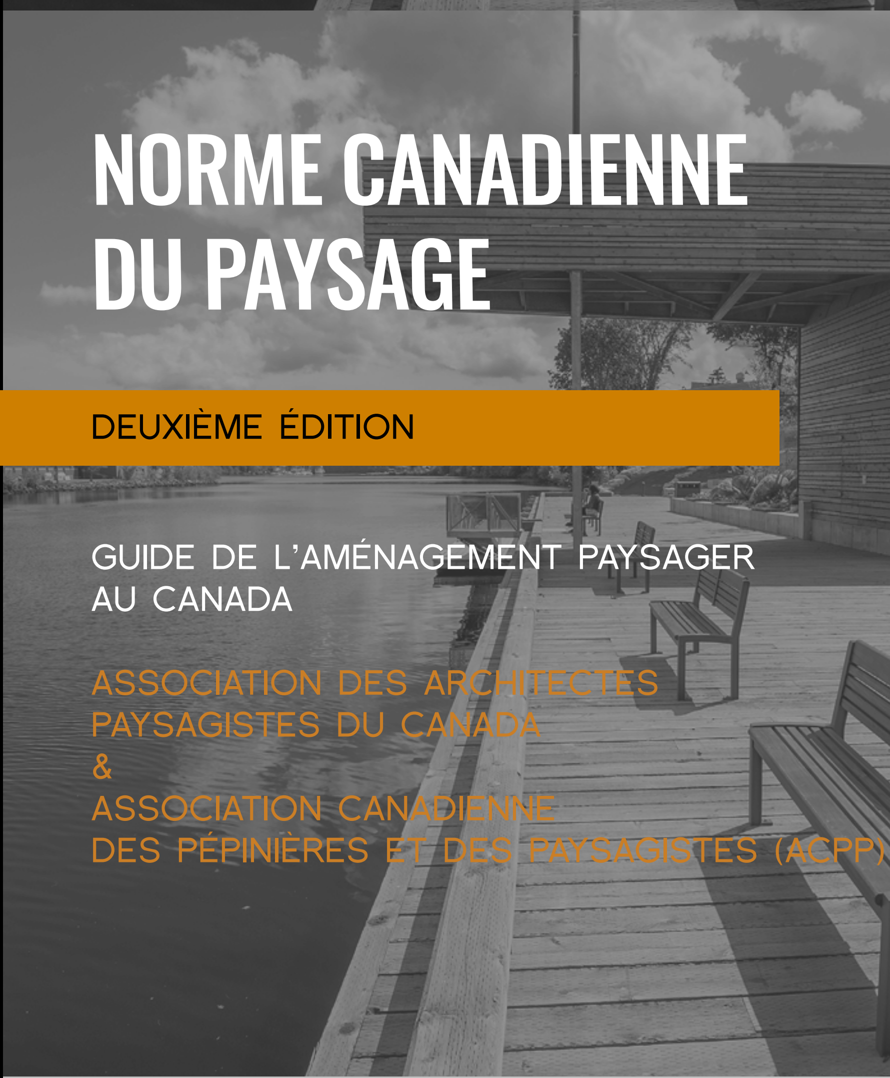

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