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A GREEN ROOFS FOR HEALTHY CITIES PUBLICATION

VOLUME 16 / ISSUE 2 / SUMMER 2014

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AUGUST 25-26, 2014

HEALTH ISSUE

Confessions of a Green Designer — Bill Browning

White Vs. Green Roofs

Green Roof Plants With Medicinal Histories

The "Dark" Side of Green Roofing

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VOLUME 16
ISSUE 2
SUMMER 2014

INSIDE

ON THE COVER: COOKFOX Architects and Terrapin Bright Green share a studio space at 641 Avenue of the Americas in New York City. Two COOKFOX Architects employees tend to the studio's green roof and apiary. Terrapin Bright Green's founder Bill Browning is interviewed in this issue about why incorporating nature into the built environment is a sound economic investment. Image provided by: COOKFOX Architects

LIVING ARCHITECTURE MONITOR®

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GREEN ROOFS FOR HEALTHY CITIES

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EXPLORING THE CONNECTIONS BETWEEN HEALTHY COMMUNITIES AND GREEN INFRASTRUCTURE

Over the past two decades researchers have begun developing tools for quantifying the multiple benefits of living green infrastructure. Living green infrastructure technologies cover a wide range of strategies from active and passive turf to trees, wetlands, structural soils, green walls and green roofs. Green infrastructure technologies are becoming increasingly recognized by policy makers as proven and effective ways to solve multiple urban problems. Yet the many contributions of green infrastructure to our natural and built environments, as well as to human health, are not fully reflected in public policies pertaining to buildings, design practice, community planning or capital and operational investments in infrastructure.

Green infrastructure can deliver many preventative health care benefits that translate into reduced expenditures for health care, longer life spans and better quality of life. With society facing rapidly-escalating public and private health care costs, multi-billion dollar infrastructure deficits, extreme weather events ranging from heat waves to floods and ice storms, broader policy support for living green infrastructure systems provides opportunities to achieve multiple dividends and address multiple needs in our communities. We need to rapidly adopt new thinking about what constitutes 'infrastructure' and implement new policies so that green infrastructure investment can complement traditional grey infrastructure to derive the maximum taxpayer benefits from the billions of public dollars invested each year.

Sincerely,

Steven W. Peck, GRP
Founder & President, GRHC

FIND OUT MORE

Read the full paper on *Exploring the Connections Between Healthy Communities and Green Infrastructure* at http://goo.gl/4YmRbL.

This topic will be more comprehensively presented during *Grey To Green: A Conference on the Economics of Green Infrastructure, Designing for Health*, which takes place August 25-26 2014 in Toronto, Canada. www.greytogreenconference.org

THE LAM INDEX: HEALTH

10
TRILLION GALLONS
Amount of untreated storm-water runoff from buildings, roads and parking lots into waterways each year

2°C
INCREASE
Temperature fluctuation when 25% of a Toronto neighborhood's tree area is removed

3.3 TIMES MORE LIKELY
Frequency that people exercise in communities with more visible greenery

46%
Decrease in crash rates in urban highway sites that have been enhanced with green landscaping

52%
Crime decrease in Illinois apartment buildings with high levels of greenery compared to those with little vegetation

See the full paper (link left) for citations.

ASTM GREEN ROOF GUIDE PASSED

At the ASTM International meeting in Toronto on April 9th, a new standard, "Guide for Vegetative (Green) Roof Systems," was passed. The 36-page document is intended to serve as a reference for green roof designers, and is a culmination of ten years' worth of development and deliberation by a green roof task group reporting to ASTM Committee E60 on Sustainability. Since forming in the early 2000's under the leadership of Michael Gibbons, the Green Roof Task Group has also passed six other standards: five related to growing media and one related to vegetation. The new standard will be subjected to an ASTM oversight process before being published.

GRHC RELEASES *GREEN PAGES: 2014 GREEN ROOF & WALL INDUSTRY DIRECTORY*

Green Roofs for Healthy Cities has released *Green Pages: 2014 Green Roof & Wall Industry Directory*. It is available online at http://issuu.com/grhcna/docs/grhc. As the green roof and wall industry continues to grow, this resource will help you find key players in the green roof and wall industry (manufacturers, distributers, suppliers, nurseries, etc.) as well as accredited Green Roof Professionals.

NEW GREEN ROOF TASK FORCE ESTABLISHED TO DELIVER POLICY RECOMMENDATIONS TO THE CITY OF GRAND RAPIDS

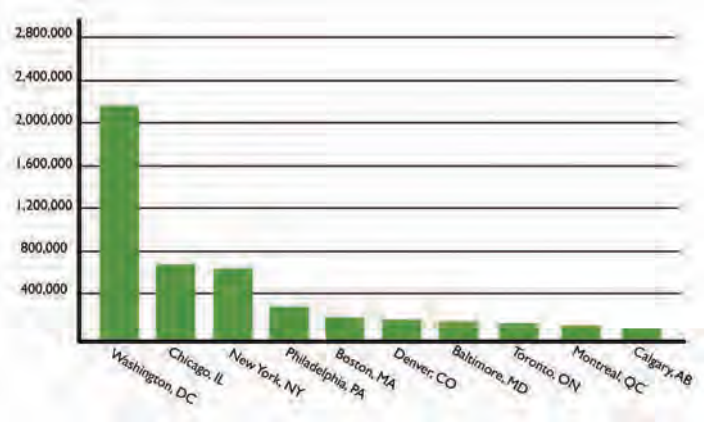
On March 27th, Green Roofs for Healthy Cities partnered with American Rivers, the West Michigan Environmental Action Council and the Lower Grand River Organization of Watersheds to host the *Grand Rapids Green Roof Market Development Symposium*. The event brought together local and statewide policymakers with green infrastructure NGOs and the private sector to explore ways to strengthen Grand Rapids' policy commitment to green roof technology. A Green Roof Task Force with local stakeholders has been established to deliver recommendations to the City of Grand Rapids by the end of 2014. For more information, visit http://goo.gl/gEJ1BY. The next *Green Roof Market Development Symposium* is planned for St. Paul, Minnesota on June 19, 2014. Visit www.greenroofs.org for more details.

GREEN ROOF INDUSTRY GROWS BY 10 PERCENT IN 2013

Green Roofs for Healthy Cities is pleased to announce a 10 percent growth rate in installed green roofs in 2013 over 2012 as part of the *Annual Green Roof Industry Survey*.

For the third straight year, the Washington, DC metro region led North America with 2,164,926 square feet of green roofs installed. Like many of the other cities that topped the list in 2013, Washington, DC has adopted policies and programs that support green roof investment. Rounding out the top five cities in North America for green roofs installed were Chicago, New York City, Philadelphia and Boston. Download the full report at http://goo.gl/MpEhrp.

TOP TEN NORTH AMERICAN METRO REGIONS IN SQUARE FEET OF GREEN ROOFS INSTALLED IN 2013



Extensive Vegetated Roofing System (Front)

Rock-IT® All-White Reflective Roofing System Beneath Photovoltaic Roofing System

Extensive Vegetated Roofing System (Back)

KEY

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Recycled Slate Path On Our Vegetated Roof

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Our commitment to sustainability reflects an 80-plus-year philosophy of extending buildings' lives through restoration and retrofitting. To see how we've converted our own 40-year-old headquarters into a leading example of sustainability, scan the code below.

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ON THE ROOF WITH... THE CLIENTS

HOW GREEN ROOFS & WALLS HAVE IMPACTED BUILDING OCCUPANTS' WELL-BEING

INTERVIEWED BY: JENNIFER FODEN WILSON

MANULIFE CENTRE GREEN ROOF IN TORONTO
Image provided by: Manulife Real Estate

In this issue of the *Living Architecture Monitor*, we explored how green infrastructure contributes to human health and well-being. In addition to addressing health concerns such as the urban heat island effect and outdoor air pollution, green infrastructure in commercial or residential properties can increase employee productivity and property values, by providing visual and physical access to green space. We spoke to three clients to find out how their green roof and wall projects have impacted their building's occupants—from employees to residential tenants.

HANOVER ARCHITECTURAL PRODUCTS
(16,000 square foot (sf) green roof)

Hanover, Pennsylvania

Kevin Repasky, director of operations, Hanover Architectural Products

Completed 2012

IRVINE COMPANY OFFICE PROPERTIES
(200 sf living wall)

Los Angeles, California

Sherry Mashadian, manager, operations, Irvine Company Office Properties

Completed 2013

MANULIFE CENTRE
(75,000 sf green roof)

Toronto, Ontario

Michael Bardyn, managing director, Greater Toronto, Manulife Real Estate

Completed 1998

WHAT AFFECT, IF ANY, HAS THE GREEN ROOF AND/OR WALL HAD ON YOUR BUILDING'S OCCUPANTS?

KEVIN: The response that our employees had was and is overwhelmingly positive. Because our company manufactures products that are used in conjunction with green roofs, it gave our employees firsthand experience of how our products fit seamlessly into green roof design and construction. The investment into what was unusable space and the environmental benefits increased company-wide awareness, exposure and appreciation of the overall design.

MICHAEL: The Manulife Centre's green roof was completed in the late 1980's and was created as an amenity to the building's residential tenants (commercial and retail tenants do not have access to the green roof). The garden is split between two locations, with the Bank of Montreal having their own use (and view) of the second location. It is considered to be a garden in the heart of the city, a quiet and tranquil place for tenants and employees to use at their leisure, hidden above the bustling corner of Bay and Bloor Streets.

HOW DO THE OCCUPANTS UTILIZE THE GREEN SPACE? WHO IS RESPONSIBLE FOR THE MAINTENANCE OF THE GREEN ROOF AND/OR WALL?

KEVIN: The space has become

HANOVER ARCHITECTURAL PRODUCTS GREEN ROOF IN HANOVER, PENNSYLVANIA

Image provided by: Hanover Architectural Products

a gathering place and a focal point for various company functions from breaks to lunches and events. The space is also used as a product display to show clients the function and use of our products in conjunction with green roof design.

SHERRY: Our living wall is located in our lushly landscape courtyard which includes a fountain and soft seating. Our customers generally take lunch breaks or even conduct team meetings. We've hired a specialized contractor to maintain the living wall.

MICHAEL: The green space includes grass, trees, flowers and plants with patio furniture dispersed throughout. The space is used by tenants as an amenity and a space to relax and enjoy nature. The space is maintained by Manulife Real Estate.

HAVE YOU NOTICED ANY FINANCIAL IMPACTS?

SHERRY: The living wall is definitely one of the greater features to the building and an added value to the project. The visitors and guests are always admiring the living wall. It's also a tour stop for our leasing team. The living wall is definitely an amenity for the tenants and visitors to the property.

MICHAEL: Our green roof has been in place for a long time. Our primary purpose was to provide our residential tenants with a unique building amenity that incorporated nature and

ACCORDING TO A STUDY CITED IN TERRAPIN BRIGHT GREEN'S *ECONOMICS OF BIOPHILIA* REPORT, 10% OF EMPLOYEE ABSENCES CAN BE ATTRIBUTED TO ARCHITECTURE WITH NO CONNECTION TO NATURE.

THE 1330 BOYLSTON STREET APARTMENT IN BOSTON, NEAR FENWAY PARK, IS GENERATING $120,000 IN ADDITIONAL ANNUAL REVENUE FOR UNITS THAT OVERLOOK A NEWLY INSTALLED GREEN ROOF. AT A 5-PERCENT CAP RATE, J.P. MORGAN ASSET MANAGEMENT ESTIMATES THE GREEN ROOF HAS IMPROVED THE VALUE OF THE PROPERTY BY $2.4 MILLION.

THE BANK OF AMERICA TOWER AT ONE BRYANT PARK IN MANHATTAN WAS DESIGNED TO ENSURE THAT 90% OF ALL EMPLOYEES HAD VIEWS TO PARKS, GREEN ROOFS AND/OR RIVERS, SPECIFICALLY TO CREATE AN ICONIC BUILDING WITH THE EXPLICIT PURPOSE OF ATTRACTING AND RETAINING THE BEST EMPLOYEES.

nature and created an oasis. We believe it has a very positive affect on our tenants as evidenced by our low vacancy rate which drives long-term value for the property.

HAVE YOU ENCOUNTERED ANY CHALLENGES?

KEVIN: The site is fairly windy, which posed a challenge for stabilizing the trees that were installed on the green roof. During the installation, Roofmeadow decided to reconfigure the tree stabilization technique that had been implemented in order to better secure the trees. As a result, an improved method of tree stabilization was developed.

SHERRY: I'm glad to report we have not had many challenges just a few minor plant issues

IRVINE COMPANY OFFICE PROPERTIES LIVING WALL IN LOS ANGELES, CALIFORNIA
Image provided by: Brandon Kendall

(replacements) during the initial roll out but it's always a growing period.

MICHAEL: Not at this time, as we have been managing the roof for almost 20 years, so we feel we have a good grasp of how to keep it a living and green space that our tenants can enjoy.

Jennifer Foden Wilson is the editor of the Living Architecture Monitor *magazine.*

FIND OUT MORE

To read about the teams who worked on these projects, visit http://goo.gl/jwNX6.

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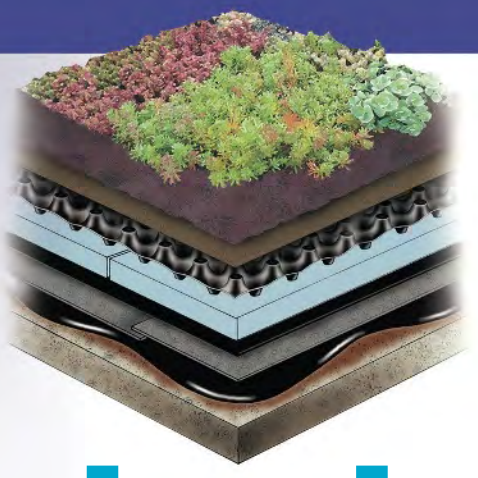

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HYDROTECH®

BLOWIN' IN THE WIND

THE DEVELOPMENT OF A WIND RESISTANCE PRODUCT STANDARD FOR GREEN ROOF ASSEMBLY

BY: BAS BASKARAN

In North America, the statistics indicate that in 2009 about 1 million square meters (3.3 million square feet) of roof system (RS) area were covered with a green (vegetated) system (VS). Ongoing development of the industry occurs with the help of federal legislation, local government incentives and advanced research. The City of Toronto became the first major municipality in North America to mandate that most new developments should cover up to 60% of the roof area with vegetated systems. This legislation is indeed a breakthrough. However, the technical information on the performance of vegetated systems and its impact on roofing system durability—especially for wind forces is not available for the Canadian regulatory environment. Wind effects on the vegetated roof assembly (VRA) are a factor in the design of a building. To address this issue, the National Research Council of Canada (NRC), in collaboration with members of the Canadian roofing industry and green roof system manufacturers, has initiated a standard development study. The main objective of this collaboration is to evaluate the wind resistance performance of VRA with pre-grown or pre-cultivated VS, and to develop a national standard for possible inclusion into building codes.

WIND UPLIFT RESISTANCE

For the wind resistance design, the prerequisite is that the resistance of the VRA should be greater than the design load. In Canada, the roof cladding design load is determined from the National Building Code of Canada. The experimental work is being carried out at the NRC's Dynamic Roofing Facility on a 16 x 32 foot testing table. A series of testing was conducted with three pre-grown modular VS and one protected membrane roofing system (PMR). With these four sources, ten different assemblies were tested in

THE STANDARD WILL PROVIDE A TOOL TO THE ROOFING COMMUNITY AND GREEN ROOF SYSTEM MANUFACTURERS TO DEMONSTRATE WIND RESISTANCE COMPLIANCE TO SATISFY BUILDING CODE REQUIREMENTS.

accordance to the Canadian Standards Association (CSA) dynamic test protocol. All the tested assemblies had three rooftop penetrations (pipe and two curbs, and a parapet) in their assembly layout. The wind uplift performance of the VRA was evaluated based on two criteria: failure of the RS and maximum allowable uplift deformation. The deflection of the VRA was measured by installing deflection sensor below and above the VRA/PMR.

BIOROOF SYSTEMS INC. OVERSEES PREPARATIONS FOR THE WIND UPLIFT RESISTANCE TESTS OF THEIR BIO-MODULE VEGETATED ROOF SYSTEM
Image provided by: National Research Council

WIND FLOW RESISTANCE

To understand the flow aerodynamics of the VS, preliminary series of wind flow testing experiments were conducted. The wind flow test setup comprised of a test rig, wind anemometer, wind flow simulator, pressure sensors and data acquisition system recording all the measurements. The wind flow simulator is a 550 HP fan that is capable of delivering a horizontal stream of air through a circular opening of 8.5 ft diameter at a velocity not less than 130 mph. To simulate the appropriate flow dynamics on the VS, a series of experiments were conducted by varying fan heights and distance until the optimum distance of the wind flow simulator from the VRA specimen was determined. These series of experiments allowed establishing the wind flow parameters, such as the wind speed protocol, optimum distance of the wind flow simulator, pressure tap designs for the VS and optimum pressure tap locations on the VS and RS. A generic modified bituminous roofing system similar to the one used at the flow testing was used whereas for the vegetated system, only one was used for all the investigations. Three key parameters were investigated: effect of mock up size, wind angle and edge restraint.

Based on the above testing, a generalized standard has been drafted and submitted to CSA for public review. The standard will provide a tool to the roofing community and green roof system manufacturers to demonstrate wind resistance compliance to satisfy building code requirements.

Bas Baskaran is a group leader at the National Research Council of Canada.

EDITORIAL REVIEW BOARD

For questions about joining the editorial review board, submitting manuscripts or policies and procedures, contact editor, Jennifer Foden Wilson, jfodenwilson@greenroofs.org or 416-971-4494 ext. 231.

JOURNAL OF LIVING ARCHITECTURE

The Journal of Living Architecture (JOLA) is the official, peer-reviewed journal of Green Roofs for Healthy Cities, an interdisciplinary trade and professional organization, linking research, design and policy with the industry.

The JOLA is written, reviewed, and edited by living architecture research professionals, sharing with their colleagues: successful educational applications, original research findings, scholarly opinions, educational resources and challenges on issues of critical importance to living architecture professionals and educators.

The JOLA is published exclusively on the *Living Architecture Monitor* magazine website. The magazine will publish the abstract of each published JOLA manuscript, with a link to the full paper online.

ISSUE NO.3

Vegetation Characteristics of Green Façades, Green Cloaks and Naturally Colonized Walls of Wooden Barns Located in the Mid-Atlantic Region of North America
D. Tilley, S. Matt and L. Schumann

We quantified the amount and diversity of vegetation on ten green façades and compared it to nine naturally colonized wooden barns located in the humid temperate climate of eastern North America. The leaf area index (3.3 m2-vegetation/m2-wall) and canopy thickness (61 cm) of the green façades was nearly identical to that of the barns (3.1 and 69 cm), indicating that green façades mimic nature's architecture. Predicting the biomass of façades from models developed for the barns' canopies, indicated they should range from 1000 to 1400 g/m2 (5600 to 8000 g/m2, fresh weight) but could be as much as 2900 g/m2 (21,000 g/m2 fw). The façades included a total of 14 vine species while the barns included 8. There was an average and maximum of 3.2 and 6 species on the façades and 2.3 and 4 on the barns. The biodiversity of the cultivated system closely mirrors the colonized system, suggesting that an optimum biodiversity may exist for vertical, vine-based living architectures.

Development and Features of the Green Roof Energy Calculator (GREC)
D. Sailor and B. Bass

A data base-driven web tool has been developed from detailed energy modeling simulations to enable green roof practitioners to explore the energy, water, and urban climate implications of design decisions. Provided with basic characteristics of a green roof project, the Green Roof Energy Calculator performs a multi-layered interpolation within a database of 8000 simulations to estimate whole building energy use, stormwater runoff, and sensible and latent heat exchange with the urban atmosphere. Output from each user query produces information for the specified green roof system, but also includes information for alternatives of both white and dark membrane roofs.

FIND OUT MORE

Read the entire papers here: http://goo.gl/o1bk54.

See what green roof and wall research was published in other journals from February 2014 to April 2014: http://goo.gl/jwNX6.

COMPARING APPLES TO ORANGES

WHITE VS. GREEN ROOFS AND A NEW DOCTRINE

BY: STEVEN PECK

Comparing white (cool) and green (vegetative) roofs is like comparing apples to oranges, except that apples and oranges have more in common! The latest life cycle cost benefit study of white, green and black roofs from researchers at Lawrence Berkeley National Laboratory has stirred up a lot of controversy. The media has reported that white roofs are three times better than green roofs at addressing climate change. While that may be true in some cases, Art Rosenfeld, one of the co-authors also reported that "the difference between green and white is trivial when averaged over 50 years."

One of the problems with most white vs. green roof comparisons is that researchers typically focus on one or two benefits associated with white roofs and neglect the full range of public and private benefits that green roofs can provide. The second limitation we see in these studies is to disregard the climate context in which they are placed. White roofs for example, can actually result in a net loss of energy in colder climates during winter months, thereby increasing overall energy use. Crafting comparisons that selectively ignore certain benefits and that fail to take into consideration the overall context often make headlines. These simplistic comparisons are at best a waste of limited research resources, and at worst generate misleading information that negatively impacts good roofing decision making.

Where might that leave us in terms of making good roofing decisions? Roofing decisions have become a lot more complicated than they were even fifteen years ago. Traditionally roofing decisions have largely been dominated by a "least first cost" approach. However, a titanic shift is now well underway, characterized by the growing list of roof-applied technologies that capture water,

CLIENTS SHOULD BE ENCOURAGED TO LOOK AT THEIR ROOFS AS A RESOURCE AND BE PROVIDED WITH A VARIETY OF OPTIONS ON WHAT WORKS IN THEIR PARTICULAR CLIMATE, SITE AND BUSINESS CONTEXT.

bring natural light into the building, generate electricity from the sun and wind, reduce the urban heat island, produce food, reduce cooling loads, clean the air, provide habitat for rare plants and animals, keep employees healthy and productive and create new educational and recreational spaces. Roof real estate is becoming more and more valuable because we now have a multitude of new technologies that can drive a value proposition for the building owner. Now we need a new way of thinking about the roof decision—something that goes well beyond simplistic comparisons and achieving the "least first cost." We need manufacturers, designers and owners to look at multiple benefits, and focus on a longer-term and broader value proposition for both the client and the community.

This decision making process should be called "The Doctrine of Highest and Best Possible Use." This doctrine means considering the best, most optimal long-term use of roof space given the nature of the building, the climate, the type of savings and revenues that may be generated and the public policy environment.

Clients should be encouraged to look at their roofs as a resource and be provided with a variety of options on what works in their particular climate, site and business context. Only after these opportunities have been fully exhausted, should we revert to roofing decisions that result in minimal or narrowly-scoped benefits. In many cases, this doctrine will result in the use of white roofs, because of the lack of loading capacity to accommodate other technologies. However, putting a white roof on a building that could be designed to support solar panels, grow food or provide recreational space is a missed economic opportunity for building owners and a potential loss for the community. Let's not waste limited research capacity, or cloud our thinking with overly simplistic and misleading apples versus oranges comparisons. Instead, let's work to make the most of our roofing real estate resources by applying the doctrine of highest and best possible use.

Steven Peck, GRP is the founder and president of Green Roofs for Healthy Cities.

CONFESSIONS OF A GREEN DESIGNER

UNDERSTANDING THE LINK BETWEEN GREEN BUILDINGS AND HUMAN WELL-BEING WITH BILL BROWNING

INTERVIEWED BY: JENNIFER FODEN WILSON

For over two decades, Bill Browning has worked to develop sustainable design solutions for business and government. He was a founding member of the US Green Building Council's board of directors and he established the Rocky Mountain Institute's Green Development Services. In 2006, with three partners, he founded Terrapin Bright Green, a firm that crafts environmental strategies for governments, corporations and complex real estate projects. In 2012, Terrapin Bright Green published the report *The Economics of Biophilia*, which illustrates that incorporating nature into the built environment is a sound economic investment. For this issue of the *Living Architecture Monitor* we decided to explore the theme of health—and Browning, more than anyone, understands the link between green buildings, roofs and walls and human well-being.

YOU'VE BEEN A GREEN BUILDING ADVOCATE FOR MORE THAN TWO DECADES. WHAT IS YOUR PROUDEST ACCOMPLISHMENT/PROJECT?

I've been privileged to be able to work with a number of incredible clients and projects—it would be hard to pick one. It has been an amazing experience to be involved in the early days of the AIA Committee on the Environment, the US Green Building Council and other groups. Maybe the most important contribution I and my colleagues have made is bringing attention to the link between green buildings and human well-being.

WHAT SURPRISED YOU MOST ABOUT *THE ECONOMICS OF BIOPHILIA* RESEARCH?

While collecting case studies for a book on green real estate development in the mid 1990's at Rocky Mountain Institute, we began to find examples of dramatic increases in productivity associated with green buildings. We published some of these examples in *Greening the Building and the Bottom Line* in 1994, and eventually we came to realize that these gains in productivity were partial indicators for improvements in well-being. That led to an exploration of biophilia.

Biophilia is the innate need of humans to affiliate with nature. It has profound psychological and physiological benefits, so Biophilic Design is the effort to reconnect humans with nature within the built environment. *The Economics of Biophilia* came about as a result of a couple of things. First a couple of clients asked us to update our database on biophilia research. In the process of doing this we discovered that the field had expanded dramatically and now included strong evidence from neuroscience and endocrinology. Second, when having conversations with clients about biophilia, we would get many nodding heads, and positive comments, but little action. So *The Economics of Biophilia* is a giant

back-of-the-envelope exercise to express the magnitude of financial benefits of biophilic design.

HOW WOULD YOU DESIGN A GREEN ROOF AND/OR WALL FOR MAXIMUM BIOPHILIC BENEFIT?

First and foremost, make it visible from a seated position. The second would be to have plants that move in a breeze or as a result of air from a vent. The movement of grasses and leaves, particularly in our peripheral vision, will get and hold our attention (and get us to look up from the computer screen). Spending too much time with the short visual focal distance of under one meter can lead to eye strain, muscular fatigue and headaches—a brief distraction that gets us to look up and to a distant view every 20 minutes or so will help prevent eye strain and fatigue.

CAN YOU SPEAK TO THE RESEARCH YOU HAVE BEEN DOING TO IDENTIFY THE SCIENCE BEHIND DESIGNING BUILDINGS WITH NATURE?

Biophilic design measures fall into three main categories: Nature in the Space, Natural Analogues and Nature of the Space. We have identified 14 patterns that then describe how to connect people with nature within those categories. The intent is that the experiences engendered by these patterns help lower stress levels, improve creativity and cognitive function, and just make for happier people.

The patterns were developed somewhat by working backwards from the science. So looking at the psychological and physiological responses and then asking what in the surrounding space was the proposed causal agent. Then, describing that spatial element or condition as a pattern. We were inspired by the old architectural pattern books, and by Christopher Alexander's *Pattern Language*.

BASED ON THIS RESEARCH, HOW DO YOU THINK GREEN ROOFS AND WALLS CAN CONTRIBUTE TO HUMAN HEALTH?

A good quality view to nature can lower blood pressure and heart rate. In a hospital setting a view to nature can improve healing rates. Green roofs and green walls are a great tool for implementing biophilic design.

Jennifer Foden Wilson is the editor of the Living Architecture Monitor *magazine.*

14 PATTERNS OF BIOPHILIC DESIGN

NATURE IN THE SPACE
- Visual Connection with Nature
- Direct Connection with Nature
- Non-rhythmic Sensory Stimuli
- Natural Ventilation
- Access to Water
- Connection with Natural Systems
- Dynamic & Diffuse Light

NATURAL ANALOGUES
- Biomorphic Forms & Patterns
- Material Connection with Nature
- Complexity & Order

NATURE OF THE SPACE
- Prospect
- Refuge
- Mystery/Enticement
- Risk/Peril

CHECK OUT WWW.TERRAPINBRIGHTGREEN.COM FOR THEIR NEW PAPER *14 PATTERNS OF BIOPHILIC DESIGN*.

FRONT: TERRAPIN BRIGHT GREEN GREEN ROOF IN NEW YORK CITY
Image provided by: Bill Browning

TOP: BILL BROWNING
Image provided by: Olin J Nettles

FIND OUT MORE

Read the extended interview at http://goo.gl/jwNX6.

Hear Bill Browning's keynote speech "The Emerging Science, Health and Economic Benefits of Designing our Buildings with Nature" at *Grey to Green* in Toronto, August 25-26, 2014. www.greytogreenconference.org

The Economics of Biophilia: http://goo.gl/Rqwv0W.

GREEN ROOF LEADERSHIP

ADRIANNE WEREMCHUK, GRP, RLA, ASLA, ISA

POSITION/COMPANY:
Associate Landscape Architect, AECOM Design + Planning

LOCATION:
New York, NY

Image provided by: Adrianne Weremchuk

WHEN DID YOU BECOME A GRP (GREEN ROOF PROFESSIONAL)?:
2013

WERE YOUR CAREER AMBITIONS ALWAYS ENVIRONMENTALLY DRIVEN?:
From a very early age I was always interested in reclaiming blighted urban settings with new life in plants and landscapes. Having grown up in the New York area, I have memories of driving through neighborhoods where I sensed a strong need for revitalization. I wondered what could be done to make these spaces more livable. Flash forward to the twenty-first century, I finally switched gears from traditional architecture to landscape architecture. This was partly inspired by living in the middle of a very dense urban neighborhood in New York City, with access to my very own green roof.

WHAT ARE SOME OF THE PROJECTS YOU'VE WORKED ON SINCE BECOMING A GRP?: I've been working on several projects for both public and private clients in New York City that are at various stages of development, including green roofs for WTC Liberty Park, as well as at-grade plazas on East 50th Street and Northside Piers in Brooklyn. I'm looking forward to many more opportunities now that I have established myself as a resource for this work.

HOW HAS YOUR EXPERIENCE AS A GRP IMPACTED YOUR BUSINESS OR WORK?:
I often find myself educating people on the meaning of the GRP designation, as well as the benefits of green roofs—this usually is followed by great interest and future referrals.

WHAT IS YOUR VISION FOR THE LIVING ARCHITECTURE INDUSTRY THROUGHOUT THE NEXT DECADE?:
I dream of seeing 100% green roof coverage on every possible rooftop in Manhattan. I believe that policy and tax incentives, as well as a cultural shift of greater desire to install green roofs will help work towards this.

CITIESALIVE

12TH ANNUAL GREEN ROOF & WALL CONFERENCE

NASHVILLE: NOVEMBER 12 - 15, 2014

WATER: THE KEY TO EVERYTHING GREEN

Nashville Music City Center
Photo Courtesy of Greenrise Technologies, LLC

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WATER: THE KEY TO EVERYTHING GREEN

WHY WATER WILL BE THE TOPIC ON EVERYONE'S MIND AT *CITIESALIVE* IN NASHVILLE, TENNESSEE THIS NOVEMBER

BY: REBECCA BLACK

The green roof and wall industry has always been focused on the role of water—we can't sustain green roofs and walls without it. Green Roofs for Healthy Cities' long-term goal is for the industry to install 1 billion square feet of green roofs and countless green walls by 2022 across North America. Almost all of these projects will require water systems. In some parts of the country there is too much water, while others suffer from drought.

The theme of this year's *CitiesAlive: Green Roof & Wall Conference* is "Water: The Key To Everything Green." Programming will feature provocative panel discussions, inspiring plenaries and industry experts speaking on the various ways in which green roofs and walls can play a key role in onsite stormwater management and a more holistic approach to water use and reuse. Here are some great examples of why water will be the topic on everyone's mind in Tennessee.

OPENING PLENARY: THE GREAT DEBATE—TO IRRIGATE OR NOT TO IRRIGATE

The new LEED v4 outdoor water use reduction standards may trigger the removal of irrigation systems on green roofs. Is this good for projects? Or does it threaten viability and longevity? How will green roof and wall installations survive in the face of climate change and unpredictable weather patterns? Tackling this topic head on will be *CitiesAlive* water ambassador Warren Gorowitz, vice president of sustainability at Ewing Irrigation, joined by Lynda Wightman of Hunter Industries, Lois Vitt Salle of Wight and Company,

and other thought leaders from the sector.

NET ZERO WATER: BOOT CAMP LAUNCH

Green Roofs for Healthy Cities has developed a comprehensive series of integrated water management training courses, in conjunction with a member-based working group and the support of Ewing, Hunter Industries and Jeffrey L. Bruce and Associates. The courses cover everything from water capture and storage to treatment and reuse. We are pleased to announce the roll out of the first two-day Net Zero Water Boot Camp, scheduled November 11-12 to kick off *CitiesAlive*. Other ½ day training opportunities include rooftop urban agriculture, green roof maintenance and more. Upgrade your professional expertise and earn CEUs in Nashville this fall. Visit www.citiesalive.org/training for courses, details and registration.

INSPIRING PROJECT: NASHVILLE MUSIC CITY CENTER

Right next door to the *CitiesAlive* venue is the spectacular LEED Gold certified Nashville Music City Center featuring a 4-acre green roof. Learn more about the comprehensive onsite water management plan, and implications of the project in terms of Nashville and Tennessee's water management policies and restrictions.

INDUSTRY EXPERTS TAKE ON THE WATER THEME

Each year, *CitiesAlive* features up to 100 panel presenters that address the most up-to-date research, policy and design that drives excellence in the living architecture sector. This year is no exception, featuring two days of top notch programming in the following areas.

RESEARCH

Investing in Irrigation to Maximize Cooling and Insulation by Dr. Tijana Blanusa, Royal Horticultural Society / University of Reading

The Effect of Water Balance on Green Roof Benefits by Dr. Bradley Rowe, Michigan State University

Comparing Economic and Ecological Benefits of Green Roof Systems by Glenn Williamson, Amber Real Estate, LLC

DESIGN

2014 Top 10 List of Hot Trends in Greenroof & Greenwall Design by Haven Kiers, Greenroofs.com

Roofing Systems: Roof Leak Testing Methods, Overburden Applications and Managing Expectations featuring Matthew Durrett, International Leak Detection; Richard C Hayden, American Hydrotech; and Richard Stever, Carlisle Construction Materials

Irrigation on Green Roofs: Conversation and Case Studies by Molly Meyer, Omni Ecosystems

POLICY

Green Gold: Sustainable Currency from Design through Implementation by Janice W. Annunziata, US Environmental Protection Agency

Green Infrastructure for Urban Watershed Management by Neal Shapiro, City of Santa Monica

Using GIS to Analyze Green Roofs as Stormwater Management by Rob Crauderueff, Crauderueff & Associates

NASHVILLE OMNI HOTEL: A VENUE WITH STYLE

Opened in 2013, the Omni Nashville Hotel is an authentic expression of the city's vibrant music culture. The Omni is a gorgeous modern building incorporating natural materials, a green roof and regional limestone and connects directly to the Country Music Hall of Fame and Museum. *CitiesAlive* delegates qualify for a special conference single ($239) and double ($259) room rate. Call or book online early before rooms at the discounted rate sell out.

OPPOSITE: NASHVILLE PUBLIC SQUARE, 2007 GRHC AWARD OF EXCELLENCE WINNER

Image provided by: Hawkins Partners Landscape Architects

BELOW: WESTVIEW CONDOS GREEN ROOF IN NASHVILLE

Image provided by: Greenroofs.com / Courtesy of GroWild

MUSIC CITY: A SPORTS, MUSIC AND FOOD LOVIN' HOST

There has never been a better time to come visit Music City. Voted by Conde Nast Traveler as one of the top 5 cities to visit in 2013, Nashville is booming with trendy new restaurants, an eclectic music scene and all the barbeque and hooch you can dream of. Entertainment options just steps away include the County Music Hall of Fame, Nashville Predators, Tennessee Titans and more.

Rebecca Black is the director of business development at Green Roofs for Healthy Cities. Contact her at rblack@greenroofs.org for sponsorship and trade show opportunities.

FIND OUT MORE

Learn more and register today at www.citiesalive.org.

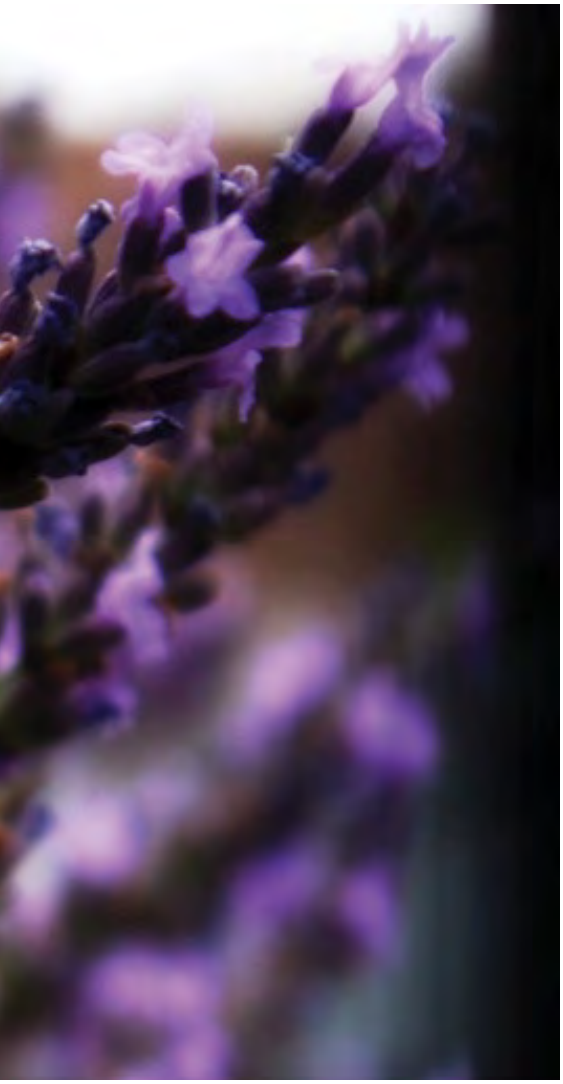
THE THERAPEUTIC ROOF

EXPLORING TWO ROOF PLANTS WITH STRONG MEDICINAL HISTORIES: BEARBERRY AND LAVENDER

BY: MARGUERITE WELLS

Many plants have a history of medicinal use, since for most of human history they were one of our only sources of complex chemical compounds. Two excellent roof plants with strong medicinal histories include Bearberry (*Arctostaphylos uva-ursi*) and Lavender (*Lavandula sp.*).

Bearberry is native to northern climates around the world, from North America to Europe and Asia. It's all the same species. A tough, woody, low-growing plant, it hovers between groundcover and small shrub—being mat-forming and low like other groundcovers, but woody and strong like a shrub. With a maximum height of about 6 inches, it needs to be kept in the foreground of any planting or it will disappear from view into taller plants. It grows slowly, can tolerate a wide range of soil pH and can endure short-term drought, low nutrients and high wind. It has small, oval, leathery leaves; and small, seedy red berries. The berries are the plant's only edible part, which are terrible for fresh eating, but are made acceptable by cooking. They



OPPOSITE TOP: LAVENDER
Image provided by: Troy Tolley

OPPOSITE BOTTOM: BEARBERRY
Image provided by: David Kingham

can be added to stews and made into jelly. Medicinally, its leaves are made into tea, which is widely-known for its beneficial effects on the urinary tract.

Very slow-growing, Bearberry can be planted en masse to cover the ground in an area, though it should have no foot traffic. It grows from seed or cuttings, albeit very slowly, so for roof plantings, Bearberry should be planted from large plugs or 1 gallon pots. Availability of quantity in the nursery trade is variable. The plant is gaining popularity so it's starting to be carried more widely, but there are few sources of the large quantities often required by green roofs. Let your grower have as much lead time as possible to ensure your supply.

Lavender (*Lavandula sp.*) has many species in the genus, and is a widely recognized and cultivated plant in the Mint family *Labiatae*. It has species and cultivars that range in height from 12 inches to 3 foot plants, and is selected for its prolific flowers, drought tolerance or high concentrations of essential oils used in the medicine and perfume industries. Its tidy growth habit makes it popular for borders, along walkways and as a mid-height ingredient in a planting bed of mixed species.

Lavender is native to Europe and Asia, where it has been cultivated for thousands of years. It also grows wild there, particularly in the dry rocky soils of the Mediterranean. Its preference for dry coarse soil makes it a natural for green roofs. It has narrow leaves that resemble the herb Rosemary; and tall violet-blue flowers that reach high above the foliage. There are species and cultivars that are more winter-hardy than others. The cultivars *Hidcote* and *Munstead* are two of the hardiest cultivars. In warmer climates, the variety is wider, and the plants can be quite a lot taller. We primarily think of Lavender as an aromatic plant, with dried flowers used in floral arrangements, potpourri mixes and body care products. Its medicinal uses include using its essential oils for its antiseptic and anti-inflammatory properties, and its use in body care products takes advantage of the soothing effect of its aroma.

Less well-known today are lavender's culinary uses, although it was popular in the colonial era. The dried flower buds are the most commonly used plant part, and can impart their delicate floral scent to dishes as disparate as lemonade or steak. A quick recipe search will give you a sample of the possibilities.

Lavender grows from seed or cuttings in the nursery, but on the roof, it needs to be planted as an established potted plant—4 inch or 1 gallon pots are the common sizes. For a green roof, the common choices are the smaller-statured varieties, since they require less water. Pruning the dead flowers back at the end of the growing season keeps the plant looking fresh for the next year, and sometimes you can get another flush of flowers in the same season.

Marguerite Wells is the owner of Motherplants.

BUILDING NEW, HEALTHY COMMUNITIES

HOW WATERFRONT TORONTO IS REVITALIZING NEIGHBORHOODS AND CREATING HEALTHY COMMUNITIES

BY: JONATHAN LASKI AND ANNA PALAMARCHUK

A lively and engaging waterfront has been coveted in Toronto by residents, governments and businesses alike for many years. The efforts of Waterfront Toronto, a tri-government organization established in 2001 by the City of Toronto, Province of Ontario and Government of Canada is delivering this long awaited renewal.

Upon completion, Waterfront Toronto's efforts will deliver approximately 40,000 new residences, 40,000 new jobs, 1 million square metres (3.2 million square feet) of commercial space and 300 hectares (742 acres) of parks and public space. The focus of the revitalization is on enhancing the natural environment, generating economic benefits and producing social-cultural gains in a triple bottom line approach to sustainability.

BUILDING HEALTHY COMMUNITIES

A healthy community is one that is liveable, accessible and welcoming. It encourages residents and visitors alike to enjoy its amenities and inspires social and cultural interactions. Healthy communities respect the use of natural resources, reduce wasteful and inefficient consumption and invite interactions with nature.

Great public space defines great cities. The first step towards building healthy communities on Toronto's waterfront involves the remediation of contaminated land. This opens development potential of these lands to public and private use. We always lead each of these neighborhood developments with new public parks or green space. These spaces serve as the spine of the new community. When we asked residents what they wanted to see most in a revitalized waterfront, they emphasized parks, open spaces and a cleaner environment. Our parks are designed to be inclusive, accessible and to offer year-round opportunities for both active and passive uses.

Waterfront Toronto has a green roof Minimum Green Building Requirement that requires each new building be

OPPOSITE: SHERBOURNE COMMON

ABOVE: CORKTOWN COMMON

Images provided by: Waterfront Toronto

WHEN WE ASKED RESIDENTS WHAT THEY WANTED TO SEE MOST IN A REVITALIZED WATERFRONT, THEY EMPHASIZED PARKS, OPEN SPACES AND A CLEANER ENVIRONMENT.

designed for a 100% intensive green roof on all low-slope roofs. Then, we require either 50% of that total available roof space to be at least an extensive roof, or in compliance with Toronto's Green Roof Bylaw, whichever is greater.

SHERBOURNE COMMON

Sherbourne Common, which straddles Queen's Quay in the East Bayfront neighborhood, offers beautiful park space from Lake Shore Boulevard East to the water's edge. It provides a perfect example of leading with parks and offering both public amenities and environmental benefits. Completed in September 2010, this park is meant to anchor the neighborhood and provide a respite for future residents and the approximately 5,000 employees and students of the adjacent Corus Entertainment and George Brown College waterfront campus. The Corus building contains a 5-storey green wall, which serves as a bold symbolic commitment to sustainability. The open lawns and engaging play areas offer visitors many recreational opportunities. With over 150 trees, there is also ample shade for resting, and the water's edge promenade at the south end allows visitors to enjoy local events every summer.

From an environmental perspective, Sherbourne Common sets the bar high. The park is the first in Canada to integrate an ultraviolet (UV) facility to treat lake and stormwater. This process removes 99.99% of all contaminates before the water is released in three dramatic art features and then flows along an urban river channel and back out to Lake Ontario. The striking pavilion is more than aesthetics—it achieved LEED Gold Certification in the fall of 2013 and requires no potable water use for its toilet facilities.

CORKTOWN COMMON

Corktown Common, in the emerging West Don Lands neighborhood, is also helping to build healthy communities

SINCE 2004, WATERFRONT TORONTO HAS CREATED OR IMPROVED 23 PARKS AND PUBLIC SPACES ON TORONTO'S WATERFRONT. TOURS OF SEVERAL OF THESE EXTRAORDINARY PARKS WILL BE PART OF THE *GREY TO GREEN* CONFERENCE IN TORONTO, AUGUST 25-26, 2014. WWW.GREYTOGREENCONFERENCE.ORG

along the waterfront. The park is an accessible, urban green oasis, with over 30 tree species, 28 plant species and a marsh teeming with wildlife.

Corktown Common, an innovative use of critical infrastructure, is located on top of the area's flood protection landform, The Flood Protection Landform is an engineered berm constructed with approximately 400,000 cubic metres (1.3 million square feet) of fill which provides flood protection to 210 hectares of land, including the entire West Don Lands neighborhood and parts of Toronto's financial district.

Corktown Common also serves as an important transit hub, connecting the Martin Goodman Trail along the water's edge with the Don Valley pedestrian and cycling trail network, thereby inviting residents from all parts of the city to enjoy its amenities. For the 2015 Pan Am / Parapan American Games, the park will be adjacent to the athletes' village and will be reserved for the exclusive use and enjoyment of the approximately 10,000 athletes, coaches and judges visiting our beautiful city.

Combined with our green building requirements and measures to ensure environmentally-friendly construction activities, we believe our parks-first approach is revitalizing existing neighborhoods and creating healthy communities along the waterfront.

Jonathan Laski and Anna Palamarchuk are project managers, environment & innovation with Waterfront Toronto.

FIND OUT MORE

Corporate Social Responsibility & Sustainability Report: sr.waterfrontoronto.ca

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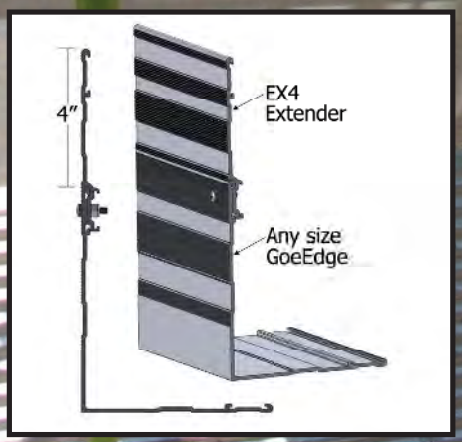

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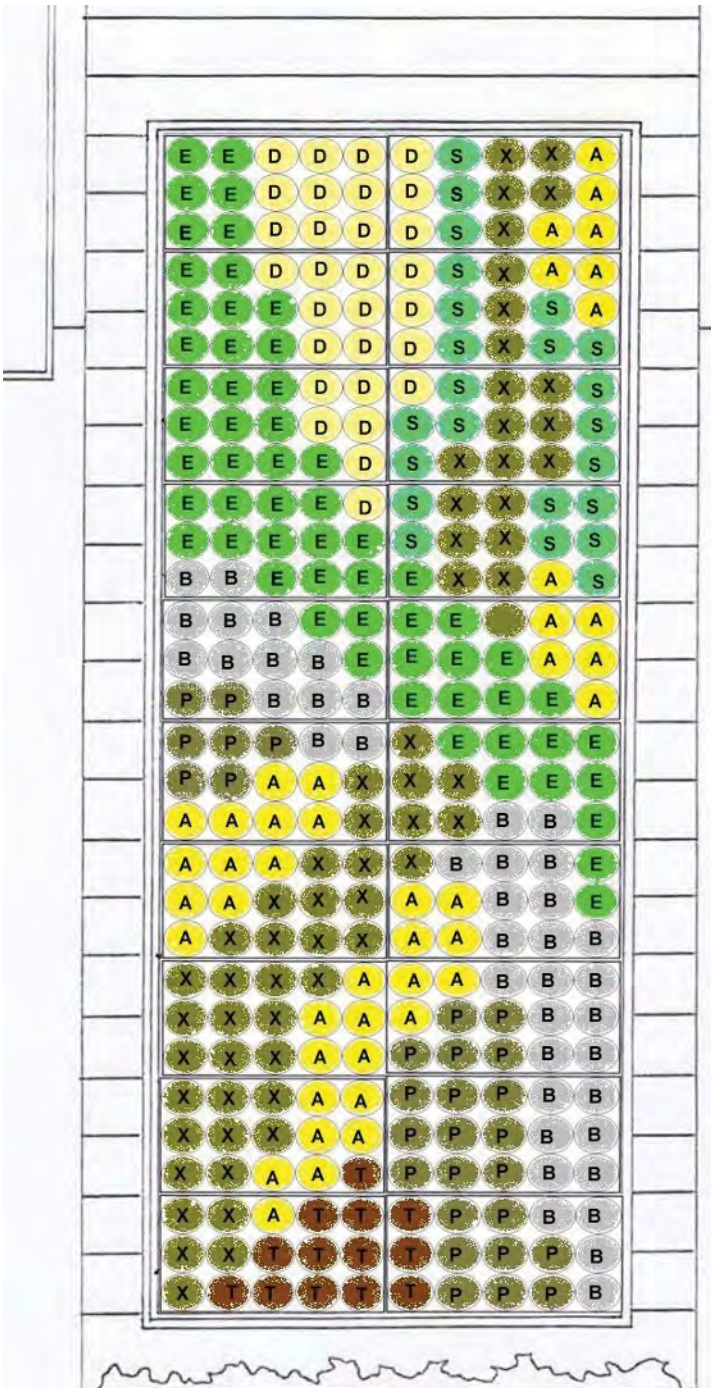
GREENING AUSTRALIA

EXPLORING AUSTRALIA'S EMERGING GREEN ROOF AND WALL INDUSTRY

BY: TRACY JACKSON



VERTICAL GARDEN PLANTING PLAN FOR CROWN CASINO PROJECT
Image provided by: Fytogreen

The Australian green roof and wall industry has grown over 50% in the last year, growing more than double the rate of North America in 2012. Sydney, Australia is poised to host to the World Green Infrastructure Congress this October, bringing together industry professionals, researchers, government officials and organizations throughout the world. Presented by the World Green Infrastructure Network and Green Roofs Australasia, the conference will shine a spotlight on green roof and wall opportunities in a market that has $5.17 billion gross national revenue for the landscape industry and $18.2 billion in revenue for the national horticulture market.

Australia's typical roof surface in the summer months can reach over 80°C (176°F). Given the climate, the energy consumption for cooling is much larger than for heating. This presents some unique challenges to design, installation and maintenance professionals that will need to be fully worked out in order to accelerate industry growth.

PET BOTTLE PROJECT IN COLLAROY PLATEAU, AUSTRALIA
Image provided by: The Green Wall Company

PROJECTS

Australia boasts the tallest green wall project in the world—the One Central Park project in Chippendale. Designed by botanist Patrick Blanc and architect Jean Nouvel, the wall is over 1,200 square meters (12,900 sf) covering 50 percent of the building façade. Reaching almost 380 feet, more than 450 species of plants are included, with half indigenous.

The largest green roof project to date in Australia is the Victorian Desalination Plant in Wonthaggi. Funded in part by the Victorian government, the roof was constructed on a 20° slope. This massive project's green roof spans more than 26,000 square meters (280,000 sf) with over 98,000 indigenous plants supplied by Fytogreen. In this drought-prone area, the roof is capable of supplying up to 150 billion liters of much-needed water to Melbourne, Geelong and surrounding areas through stormwater capture and convergence.

Encouraging youth to reduce their carbon footprint, the St. Rose and Mosman PET bottle project allowed students at St. Rose's Collaroy Plateau Catholic School to create a green wall out of recycled plastic bottles with Mark Paul, director of The Green Wall Company. "The overall objective of this first site was to show how simplistic and feasible it is for schools across Australia to adopt the project and green their own built environment," he says.

RESEARCH

Aspect Studios, in partnership and collaboration with Eco Harvest and Thermal Environmental, supported by the City of Sydney technical advisory panels and others have developed a computer thermal performance model for roofs. It will be able to give an accurate assessment of a green roof's energy saving performance. The model demonstrates compliance with the Building Code of Australia's Section J for building thermal performance for thermal resistance and thermal mass contribution of an extensive green roof on summer cooling energy demands.

Integrated Water Cycle Management is of great interest in drought-stricken areas within Australia. Sustainable Building Research Centre (SBRC) located at the University of Willongong's Innovation Campus is a 33 hectare business and research hub. The SBRC has been designed to meet the Living Building Challenge to achieve net zero energy and net zero water surrounding areas via stormwater capture and storage.

POLICY

Policy guidelines such as Melbourne's Green Growing Guide, and the Green Roofs & Walls Policy Implementation Strategy in Sydney are

TOP: THE TALLEST GREEN WALL PROJECT IN THE WORLD—THE ONE CENTRAL PARK
Image provided by Jean Nouvel

BOTTOM: THE LARGEST GREEN ROOF PROJECT TO DATE IN AUSTRALIA—THE VICTORIAN DESALINATION PLANT
Image provided by: Fytogreen

helping to support the development of the industry. Green Roofs Australasia (GRA) advocates the use of green infrastructure policy in Australia, New Zealand, the Phillipines and other countries in the region. "The industry has surged over the past 18 months due to new policy," says Matt Dillon, president of Green Roofs Australasia. "The World Green Infrastructure Congress could not be more timely for networking and sharing knowledge in the expanding green Australia environment."

Tracy Jackson is a director at Green Roofs for Healthy Cities.

FIND OUT MORE

For more photos of green roof and wall projects in Australia, visit http://goo.gl/jwNX6.

World Green Infrastructure Congress, Sydney, Australia, October 7-10, 2014 http://goo.gl/tv6iAo.

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INTEGRATED WATER MANAGEMENT FOR BUILDINGS & SITES I

Toronto - August 26, 2014 *(at Grey to Green)*

INTEGRATED WATER MANAGEMENT FOR BUILDINGS & SITES II

Toronto - August 26, 2014 *(at Grey to Green)*

INTRODUCTION TO ROOFTOP URBAN AGRICULTURE

Toronto - August 26, 2014 *(at Grey to Green)*

LIVING ARCHITECTURE AND SUSTAINABLE ENERGY

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NET ZERO WATER BOOT CAMP (LAUNCH EVENT!)

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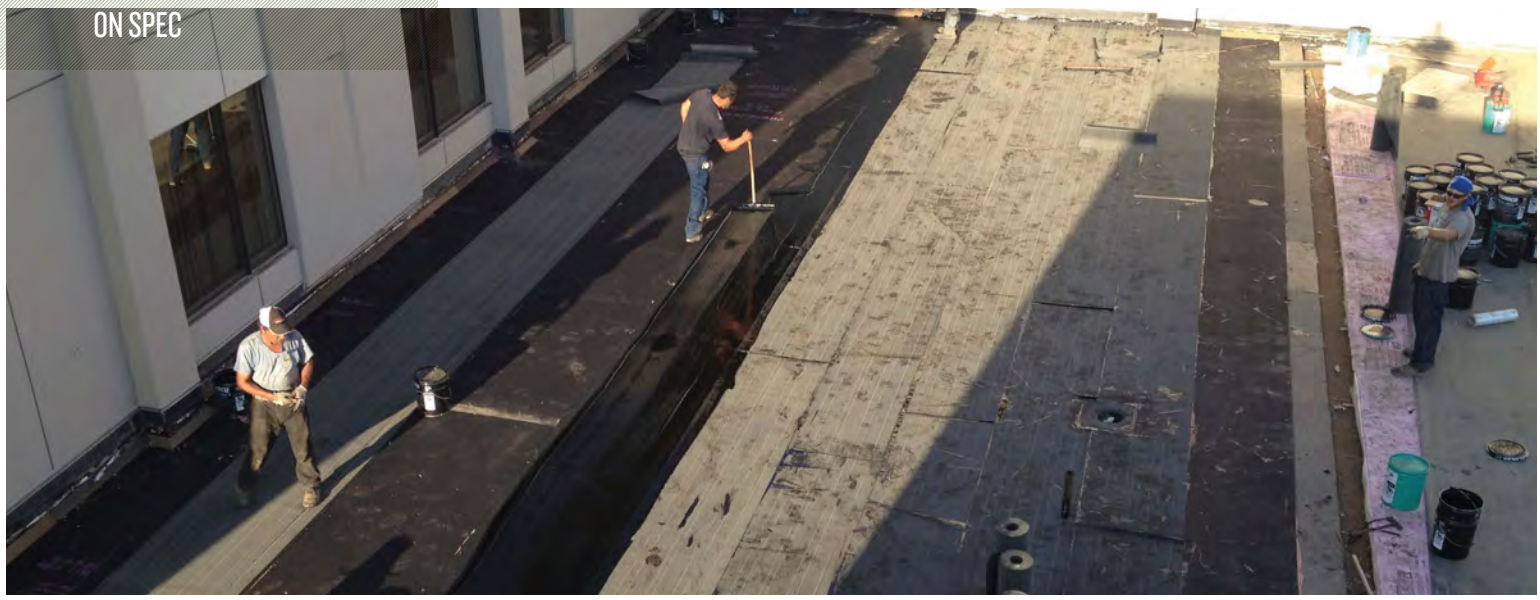

THE "DARK" SIDE OF GREEN ROOFING

HOW THE BURIED ROOF MEMBRANE DETERMINES THE SUCCESS OR FAILURE OF THE WHOLE FACTILITY

BY: ELIZABETH HART

No one wants to talk about it. It is a subject we would like to bury (so to speak). But we must face the fact that all vegetated roofs have a "dark" side. That is, a buried roof membrane which quietly determines the success or failure of the whole facility.

Roofing is the least glamorous part of on-structure vegetation, and as such it often suffers a lack of attention in design. But when the membrane fails, it is not only bad for the building and all parties involved, it affects the perception of the entire green roof industry.

There is a diversity of roof membranes to choose from, and all have their benefits and drawbacks. The good news is that most systems will function as intended if they are properly designed, installed and maintained. But each building is unique and so there is no one-size-fits-all solution, no matter how attractive the sales pitch or price.

The first step in selecting a roof membrane is to engage a qualified professional. A roofing consultant, architect or manufacturers' representative can help to determine the best solution for a given project. Does the deck have sufficient structural weight capacity and positive drainage? Will the project budget afford a thriving, long-term system? Or something that looks flashy on opening day but is destined for quick failure?

If the budget is tight and the only goal is energy savings, reflective or cool roofs may be the right solution. However, cool roofs are limited in their environmental contributions. Even the whitest roofs can get extremely hot. They do not provide insulation or habitat, nor clean the air, and they must be replaced more frequently than green roofs. They also must be maintained frequently (by washing) in order to remain reflective. That said, vegetated roofs are not a benefit to anyone if they end up in a landfill prematurely, so by all means select cool if the budget is too tight for a quality green roof.

When calculating the return on investment (ROI), take a closer look at the cost of installation. Studies consistently show that some of the least expensive membranes at install also by far have the shortest life span, and are the most expensive to maintain. The most important factor in green roof life cycle ROI is the extended life of the membrane, but this only applies to materials that stand the test of time.

Next consider liability protection. Forget about the number of years in the warranty's title and instead read the fine print. The truth is, 85 percent of leaks happen at the flashing details (perimeters and penetrations). Hence, a 30 year warranty is no good if it doesn't cover leaks where they are most likely to occur.

PROVIDENCE ST. MARY MEDICAL CENTER IN WALLA WALLA, WASHINGTON. A FULL SYSTEM TREMCO PROJECT: MEMBRANE AND GREEN ROOF SYSTEM.
Image provided by: Tremco

Give special attention to designing the most sensitive areas of the roof. Include robust flashing details and easy access to them through vegetated-free zones and drain inspection chambers. Most leaks are caused by errors during installation. Avoid this by specifying third party inspections to confirm the roof is being installed correctly, and perform a leak test before adding the green components.

Whether single-ply, built-up or fluid, all roofing systems are complex technologies requiring a high level of expertise to design, and they must be treated as such. Take the time to perform due diligence, engage a qualified professional, and keep the green side of the roof in the spotlight, and the "dark" side where it belongs—safely and securely buried.

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