Green Roof News
01/2011

International Green Roof Association
Global Networking for Green Roofs

Dear Reader,

Even established building techniques must constantly re-invent to deliver adequate solutions for future challenges and changing environmental needs. And green roof technology is no exception. For example the areas of renewable energy, natural stormwater management and biodiversity offer great opportunities to integrate the unique advantages of green roofs. Innovative projects from Canada, Germany and the UK are presented in this issue of "Green Roof News". In addition green roof policies and fire safety requirements are addressed. And last but not least the first "Greenroofs & Walls of the World™ Virtual Summit 2011" on September 27th & 28th, organised by greenroofs.com.

Have fun reading!

Wolfgang Ansel
Director IGRA

Contents

"Hymn to Nature":

The Podlasie Opera and Philharmonic Hall in Bialystok/Poland

You will find a breathtaking building in the Polish town of Bialystok, some 180 km north east of the country's capital Warsaw: the newly constructed Podlasie Opera and Philharmonic Hall. The 9,500 m² European Centre of Culture is the largest building of its kind in Eastern Europe. From the outside, it would appear that the surrounding greenery is gradually and inexorably taking over the building.

The complex appears to rise out of the surrounding landscape like a "green cube" perched on surrounding and sometimes sloping green roof surfaces – such was the vision of the Warsaw architects Marek Budzynski, Zbigniew Badowski and Adam Kowalewski. The renowned architects have already left their green mark on the new university library and on the Supreme Court in Warsaw. Both were trend-setters for green roof architecture of the future, and a new monument has just joined the list. Not only the design potential makes green roofs so important, but also increasing ecological awareness for sustainable development. "Building with Nature" is the order of the day.

Local experts: A critical factor for durable greenery and true sustainability is a correctly conducted and functional green roof system. The Polish company Green City Life (GCL Sp. z o.o.) delivered know-how and the ZinCo Green Roof system for the Opera and Philharmonic Hall in Bialystok. In addition, the GCL staff was all the time in contact with the architect and the contractor and provided them with professional technical support.

The masterplan of the project
Copyright: Budzynski, Badowski, Kowalewski

Detailed planning of the Opera and Philharmonic was done by the landscape architect Tomasz Chylinski and the landscape construction work was carried out by the experienced horticulturalists Pleneria Sp. z o.o. Sp. kom.

Visitors welcome – on the roof too: All roof areas are publicly accessible. Stairs on either side of the sloping roofs lead the visitors through the well designed green areas on paved pathways. Even the plateau of the cubed main building can be reached from outside by two 30 meter high spiral staircases. All the roof areas also have various access points from indoors and separate lifts carry guests up to the plateau. It will not be the wonderful view alone which will catch the eye of visitors, but also a memorial to the Polish rock singer and composer Czesław Niemen which is to be erected this year. A circular area planted with thyme has been prepared to receive it. A pathway lined with red leaved ornamental cherry and apple trees growing up to 6 meters in height leads to it. White to pale pink blooming yarrow grows under the trees.

Many staircases allow visitors to explore the green roof

As well as the root ball plants, many rooftops were planted with a special seed mixture "Meadow Flowers". Such ready to sow mixtures, which are attached to the surface with an organic glue, are especially efficient for larger surface areas as the amount recommended is about 25 g per m^2. The "Meadow Flowers" vegetation fall into the category of extensive greening: the drought resistant species can survive without extra watering whereas the areas with intensive greening (lawns, bushes, trees) do need extra water in dry periods. This is carried out by means of drop-by-drop irrigation.

The plants convert the roof into a sea of flowers

Green from top to toe: A large part of the landscape architecture concept includes the greening of all vertical areas. All the facades of the towering cubic main building have been fitted with trellis for climbing plants to grow on. These include not only evergreen plants like ivy, but also vines and clematis which lose their foliage in the autumn. Knotweed, an extremely fast growing climber which is very popular for large surfaces, was also used. All of these climbing plants are rooted on the roofs and enjoy suitable conditions for durable growth. What is striking about the landscaping is that there are also lots of small green areas. The pillars at the entrance, which are themselves covered in tendrils, also have wall greenery at the very top: weeping willow with hanging habitus, consecutively. A single silver birch crowns the small roof of the plateau lift. Everything is green, no matter where you look.

Green future: Landscape work was finished on the Opera and Philharmonic Hall in 2010 and it is now only a question of time until the vision of the Warsaw architects is fully realised. Green has been planted in incomparable variety and variations and is now in uninterrupted growth. And, seeing as all roof areas are publicly accessible, people can also fully experience this green abundance. Green is not only the trademark of the Opera and Philharmonic, green is also the sign of the future. Bialystok's new Opera and Philharmonic gives it yet one more argument in its favour in the contest to be the European City of Culture in 2016.

This park is located on the spacious roof surface, which leads around the main building

Integrative Strategy:

The Vancouver Convention Centre Living Roof

As cities grow, many aspects of our environment are adversely affected. Urbanization contributes to regional local climate warming, compromises habitat for insects and songbirds, the key pollinators of ornamental plants and food-based crops and disseminators of seeds. As a plant-based system, the ecology of the highly visible green roof or habitat living roof at the Vancouver Convention Centre helps to create habitat for songbirds and insects and reduce the impact of growing local climate extremes. The extensive planted habitat roof also plays an important role in the education of the public with respect to urban habitat creation and protection. It incorporates a regionally based plant palette and system design to better face the challenges of the local environment and respond to the public interest for positive aesthetic qualities in the dense downtown core of Vancouver.

The Vancouver Convention Centre Roof Looking North and East

The Vancouver Convention Centre roof references a regional coastal grassland. It does not attempt to duplicate its ecology. It explores ideas about how the coastal grassland ecology can contribute to the regional ecology by connecting habitats, provide visual relief, mitigate runoff, and cool and clean the air. It is a unique opportunity to illustrate how these ideas can function within the urban core. Like the coastal grassland habitat, the roof of this building is part of the nature-based, green stepping stone network that encourages birds, honeybees and other insects to move between the existing natural areas within urban Vancouver including the North Shore Mountains, Stanley Park, Burrard Inlet and False Creek.

The lofty ambition of an ecology-based habitat living roof was not without its challenges. Plant selection and propagation, development of a sustainable growing medium with a consistent predictable weight, an irrigation strategy that fit the requirements of a LEED Platinum project, cost-effective control of storm water and the logistics of long term maintenance were but a few of the many hurdles overcome.

Plant Selection, Propagation and Planting: Drought tolerance, resistance to wind and a growing medium depth of 15 cm were three key plant ecological factors that related to conditions on the roof of the building. They were used as criteria to eliminate a large number of coastal grassland plants in the initial culling of species. The resulting plant list was then reviewed for aesthetic quality, biodiversity and attraction to insects and songbirds as well as their ability to co-exist with each other. The issue of aesthetic quality, although not usually at the top of the list of criteria when selecting plants for an ecological habitat, was important to the project as the Convention Centre's urban location is surrounded by hotels, office towers and condominiums all of which overlook the habitat living roof.

Irrigation: The LEED Platinum aspirations of the project put particular pressure on the design of the irrigation system. Rainfall statistics for Vancouver show that June, July and August are drought periods. The steep sloping roof planes and the 15 cm depth allowed little capacity for water storage in the growing medium matrix. As a result, irrigation was required but only for the three drought months. A site-specific moisture sensor system allow water to be added to the growing medium via the drip emitters only when moisture levels dropped below 15%, the typical wilt point for these plants. Water for the irrigation system comes from the building's black water treatment facility. When the Convention Centre is active no potable water is used to irrigate the roof.

The Vancouver Convention Centre roof in March 2011

Maintenance: Maintenance of Vancouver Convention Centre habitat living roof was an issue that surfaced early in the design process. The design team had talked about ecosystems and natural process throughout the project, rationalizing that if coastal grasslands are self-sustaining, self-maintaining ecosystems then the habitat living roof ecosystem should be able to function with very little intervention. The maintenance specifications prepared for the habitat living roof outlined the project goal of allowing the individual plant species to colonize as they saw fit reacting to variations in microclimate, slope and water. This not only provided for a rich and diverse habitat but also allowed the aesthetic to change over time. From season to season and year to year the roof planting has slight variations in colour and texture as various species of plants colonized pushing out the others.

Final Observations: The Vancouver Convention Centre living roof is now in its third year. By all accounts the public has embraced the roof as a success. Media reports and feedback to the design team celebrate the roof's aesthetic qualities. The design team has now taken on the role of habitat living roof monitor. The bimonthly walks through the collection of grasses and native herbs that thrive above the ballroom and meeting rooms of the facility has proven that this extensive living roof inspired by the coastal grassland is much more than an aesthetic success.

Bruce Hemstock
PWL Partnership Landscape Architects Inc.

Bruce Hemstock and Amy Chomowicz (Ecoroof Program Administrator Portland) on a site visit

Geese and sea gulls inspect the habitat roof

Chances and Challenges:
Implementing Green Roof Policies

Green roof policies are one of the basic key factors for the successful development of a green roof market. Longstanding experiences and case studies from different countries and municipalities are creating a source of ideas that can be adapted and modified according to the needs of the local green roof stakeholders.

Various tools can be used to promote green roofs directly or indirectly at the municipal policy level. These include, for example, regulations in new development plans or green roof by-laws for whole urban areas. Direct financial subsidies and a reduction in storm water fees add to the instruments which, together with public relations, could provide ideal support. It is also important to act as a role model by making the roofs of municipal buildings green. These various instruments have been applied successfully in Germany for more than 30 years. Even if an exact transfer of the German experience is not possible due to differing laws, the current implementation of the municipal green roof initiatives on an international level is following a very similar pattern. The following shows examples of the instruments.

Financial Subsidies: A number of municipalities are offering attractive start-up grants for those wishing to implement a green roof. The aim of the subsidies is to motivate owners of privately or commercially used properties to create voluntarily additional green spaces on the city's roofs. It is generally irrelevant whether the buildings are new or renovated. Green roofs that are required as a result of legal obligations (see below: Green roof by-laws / zoning codes) are, however, very often excluded from direct financial subsidies.

Reduced Storm Water Fees: Charging separate fees for the disposal of sewage and storm water offers a second opportunity for financial incentives. The amount of the storm water fee is normally based on the total area of the plot and the proportion of the ground that is impervious. Green roofs differ from standard tiled or gravel-covered roofs in that they are

able to store a large proportion of the water from precipitation and release any excess water gradually over time. These are recognised as unsealing measures and rewarded with a reduced storm water fee.

Green Roof By-Laws / Zoning Codes: The possibility of incorporating green roofs as a condition in urban development plans or for new building constructions that require planning permission is an approach taken successfully by many local authorities. The stipulations concerning green roofs do not only apply to current construction projects but also to urban planning zones in which development is not due for a number of years. The aim of long-term stipulation is to guarantee that local authorities continue to develop their ecological concept throughout the subsequent years.

Density Bonus: Parameters such as the number of units on a piece of property and the floor area ratio regulate the level of use for building coverage. Often investors try to gain exemption from these specifications (e.g. through increased number of units or the addition of an extra storey), in order to increase the marketability of the real estate. The Density Bonus includes the possibility of exceeding the footprint area of the surface area and/or the number of stories allowed if a certain environmental equalization is included (e.g. by installing a green roof).

Public Relations: Public relations in a community not only advocate green roofs in general, but also support the above presented instruments. The municipality should not, however, restrict itself to the role of advisor and promoter, but rather act as a role model and pace setter by landscaping the roofs of its own buildings and testing and developing new possible fields of green roof applications.

Case Studies from Europe, North America and Asia

Munich: The Bavarian regional capital Munich (Germany) is employing a wide palette of measures to promote green roofs. Some of the established instruments include regulations in urban land-use plans, grants for voluntary installation of green roofs, and a reduction in storm water fees. In particular, the obligation to landscape all suitable flat roofs with a surface area >100 m² over the past 14 years has led to making green roofs in Munich a recognised construction standard.

The aerial view demonstrates the success of the green roof policy in Germany

Rotterdam: Green roofs are an essential part of the Rotterdam Climate Initiative. Therefore, the city council encourages the installation of green roofs by granting an attractive subsidy of 30 Euro/m² for homeowners and by setting a good example and install green roofs on municipal buildings. The target for sustainable growth is very ambitious. Until the year 2014 the city is aiming to establish 160.000 m² of green roofs and gable gardens.

Portland: Portland, in the Northwest of the United States, promotes green roofs predominantly because of advantages for sustainable rain water management. The city's sewer system is stretched to the limit, so measures which relieve urban drainage are very welcome and are supported with grants. In order to establish green roofs firmly in the public mind, actions such as landscaping municipal buildings, introducing a Floor Area Ratio Bonus, and public events to be held on green roofs were used to promote a green roof strategy (see Green Roof News 2/2010)

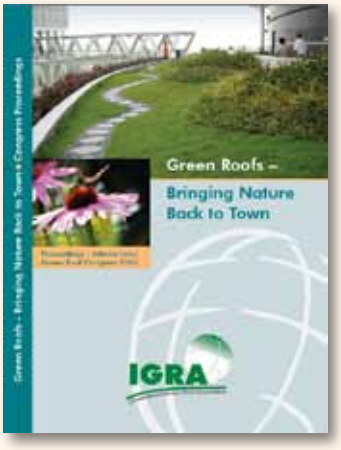
Singapore: Singapore has agreed on a comprehensive programme to promote rooftop greening in the past years in order to reach the ambitious goal of 50 hectares of new skyrise greenery areas by the year 2030. Apart from the designation of green roofs as a measure of compensation for new building projects, a Gross Floor Incentive Scheme for roofs and municipal allotment gardens, as well as financial subsidies for sustainable landscaping of existing buildings in districts with especially large green area needs have been introduced. Technical consultation is also included in the programme.

Singapore has started a very ambitious programme to support skyrise greenery

The examples given demonstrate that each city is using an individual mixture of different measures to promote green roofs. Because instruments differ not only in their scope of application but also in their institutional allocation, and because the urban environmental functions of planted roofs have overlapping specialist divisions, a combination or collaboration is normally very sensible. The goal of municipal green roof strategies should be to develop the most possible positive effects of green roofs by making the most efficient use of financial and human resources available.

Wolfgang Ansel´s presentation Green Roof Policies – an international review of current practices and future trends at the Greenroofs & Walls of the World™ Virtual Summit 2011 (see page 14 – Events) will highlight success stories and failures likewise. Information from different case studies will be merged into a "Best practice guideline for Green Roof policies".

The book "Greens Roofs Bringing Nature Back to Town" contains detailed information about the green roof strategies in Germany (Berlin, Munich, Stuttgart, Düsseldorf, Karlsruhe), Austria (Linz), the UK (London), Denmark (Copenhagen) and the US (Portland).



The Seoul Subsidy Program:

Putting the Greens on the Top



Grand prix award winning project of the 1st Korea Green Roof Award in 2009. Close to Mt. Nam-San (in the back ground of the photo, under cloud), this project covers 14,296 square meters at eleven places on top of several university buildings. This project won the World Best Roof Garden Award (Gold medal) during the Shanghai Green Roof Congress, China, May 2010.

In many Korean cities an increasing number of green roofs and green walls are created in response to increasingly higher density developments and deteriorating environment. Far from enough open spaces and greens are provided in already congested metropolises, roof greens or roof gardens are the best alternatives. Initiatives were taken by some professionals with visions in the field of landscape architecture in 1998. At the forefront was Prof. ByoungE Yang of Graduate School of Environmental Studies, Seoul National University. He organized a series of study seminars on green roofs and later he established the Korea Green Roof Association in 2003 and became the founding President of the Association.

Seoul city with its over ten million inhabitants but lacking greens was quick to adopt the green roof concept. In close cooperation and discussions with the Korea Green Roof Association, Seoul city began a program to subsidize green roofs in 2002. Half the costs of green roofs are paid with the city annual budget. During 2002–2010 a total 202,449 m^2 of 446 green roof projects have benefited from the program. In 2011 alone the city plans to support 51,527 m^2 of green roofs in 109 places, and the budget is approximately US$ 10 million. Some other local governments have adopted, or plan to start, similar incentives and/or legal requirements.

In Seoul, buildings with 99m^2 ~ 992 m^2 for green roof construction with good public access, are eligible to the subsidy program.

Priorities are given to buildings

1) readily accessible to many and diverse visitors;

2) of which roofs are potential sites for public environmental education;

3) used for major public and/or welfare purposes;

4) with positive impacts for improving awareness and environmental/amenity effects;

5) that will be key stepping stones of urban ecological networks;

6) children's daycare center, kindergarten, hospital, and others where rooftop gardens will be most intensively used.

Subsidies are up to Korean Won 90,000/m^2 (approx. US$ 90) for extensive types, and up to Korean Won 108,000/m^2 (approx. US$ 108) for semi-intensive or intensive type green roofs. Up to 50 % (or up to 70 % for those buildings visible in the foreground from the Mt. Nam-San which sits in the center of Seoul city) of costs including structural safety check, design, and construction are supported by Seoul city for private buildings. Extensive type green roofs are defined as those with 20 cm or less depth of soil and usually have ground covers or flowers. Buildings near Mt. Nam-San are given special favors. In addition to lifting the upper limit of area, they get a greater amount of support per unit area; up to 126,000 Korean Won (approx. US$ 126)/m^2 for extensive type green roof, and up to 150,000 Korean Won (approx. US$ 150)/m^2 for semi/intensive type green roof. Buildings owned by the city government are fully supported for the costs of green roofs. Other public buildings are eligible when the owners are willing to bear 30 % or more of costs.

For the purposes of promoting green roofs and improving the environment, Korea Green Roof Award was launched in 2009 by the Association, and Seoul city government was awarded the "Best Administration Award" in the first year for the achievements of its subsidy program.

2nd place award winning project of the 2nd Korea Green Roof Award in 2010. The whole green area shown in the photo covers library buildings and digital library below.

Prompted by the promotional activities of Korea Green Roof Association and influenced by some nicely done showcase projects through the Seoul city's subsidy program, increasingly more of gray tops of many high rise buildings in Korean cities are being greened for the benefit of environment of us all.

Tong Mahn Ahn
Chair (2008-2009), Korean Green Roof Association
Professor, Chair, Dept. of Landscape Architecture and Rural Systems Engineering
College of Agriculture & Life Sciences

Green roof of a restaurant in the CBD of Seoul

Green roof and view out from Busan City Hall, Busan

Local Nature Reserve:

The Green Roof of the Sharrow Primary School in Sheffield, South Yorkshire/UK

Sheffield latest Local Nature Reserve is one of a kind – it is the first Nature Reserve in the country (probably even the first in the world) to be located on top of a building!

Like Sheffield's other Local Nature Reserves, Sharrow School's green roof was designated for its great ecological value and its importance to the local community. It also helps reduce the impact of climate change by keeping the building cool in summer, soaking up heavy rainfall and absorbing carbon dioxide from the atmosphere. Sharrow School's green roof was declared a Local Nature Reserve in 2009 on the 60th anniversary of the National Parks Act which provided the legal framework for declaring nature reserves.

Wildlife Features: The 2,000 m^2 green roof was designed to represent the variety of habitats found in Sheffield, such as Peak District limestone grassland, wildflower meadows, urban brownfield sites and a wetland area with a small pond. Plants used included directly sown annuals for high visual impact i.e. cornflowers, Limestone grassland mix, Roof meadow mix i.e. urban "Brownfield" site species, including snaps dragons and natural colonisation. The mixes contained no grasses due to there invasive nature. There is even a dead tree for birds to perch on and insects to burrow in! The roof also reflects Sheffield's distinctive landscape, with rolling hills and valleys made of locally sourced recycled materials. Bird tables and insect feeders attract wildlife, and a weather station and webcam have been installed to provide research opportunities. A fascinating array of plants and animals have made the roof their home since its creation in 2007. The vibrant mix of colourful wildflowers looks spectacular and attracts a variety of birds and insects, so the roof is always buzzing with life!

Design and Structure: 150 kg/m^2 was the lowest specified loading, rising to 250 kg/m^2 over supporting columns, here graduated mounds from 100 mm to 500 mm were used to give an average of loading and create different habitats and aspects. The protruding central atrium also serves to splits up the roof into Northern and Southern habitats.

Site Management: A management plan was written for the roof by Dr. Nigel Dunnett, Senior Lecturer in the Department of Landscape at the University of Sheffield and sponsor to the Sheffield Green Roof Centre. The aims of the management plan are to maintain the distinctive nature of the different habitat areas, to prevent dominance by aggressive species and to undertake regular botanical and faunal surveys. The management plan will be delivered by Sheffield City Council and Green Estate, a local not-for-profit social enterprise, with participation from school members and local volunteers.

Keith Missen, Environmental Planning Team Manager (Sheffield City Council) sums it up: "It's a complete one off type of roof but the interesting thing for me is how simple variations in substrate and the addition of branches and stones can do so much to increase wildlife value."

On September 27th (10:00 – 10:40 am EDT, 14:00 GMT), the Greenroofs.com Virtual Summit will host an expert panel discussion on the topic "Greenroofs and Biodiversity". The panelists – Nathalie Baumann, Christine Thuring, Gary Grant, and Dusty Gedge – will discuss original research and unique experiences, from field work upwards to bigger picture perspectives, as well as experiences with legislation on urban nature conservation.

Nathalie Baumann, research associate at the ZHAW Green Roof Competence Centre in Waedenswil (Switzerland), has been researching the requirements of ground-nesting birds for successful breeding on Swiss green roofs for six years.

Christine Thuring, currently doing her PhD in landscape ecology at the University of Sheffield (England) in partnership with ZinCo GmbH, speaks to her work on plant community development on old extensive green roofs in Stuttgart (Germany).

Gary Grant, an independent ecologist for over 30 years, reflects on his first green roof which was designed to support biodiversity in 1992.

Dusty Gedge, current President of the European Federation of Green Roof Associations and co-founder of Livingroofs.org, inspired and supported three PhD projects exploring invertebrate and avifauna on brown roofs in London (UK). The panel will be followed by a 15-Minute Live Q & A session with all panelists, from 10:45-11:00 am EDT (14:45-15:00 GMT).

European Standards:
Fire Protection Tests for Green Roofs

At the end of the 1980s concerns grew in Germany that extensive green roofs with shallow vegetation layers could be a fire risk threat on buildings where they had been installed. As a result a series of tests were undertaken by an accredited laboratory (Research and Materials Testing Institute of Baden-Wuerttemberg) to qualify the resistance of extensive green roofs to flying sparks and radiated heat. The subsequent results demonstrated that even parched/dry green roofs were perfectly able to protect the waterproofing and the subjacent layers against fire and heat, provided the substrate layer was deep enough and non-flammable.

Subsequently the following instructions were incorporated into the standards for the building inspectorate by regional authorities and the FLL Roof Greening Guideline.

Intensive greening which is irrigated, regularly maintained and generally has a thick substrate layer is to be evaluated as a hard roof (resistant to sparks and radiated heat).

Extensive green roofs are classified as "hard roofing" according to the construction regulations if:

- The substrate base is at least 30 mm and its organic content does not exceed 20 % of the mass
- The vegetation layer is designed in a manner, that if it catches fire, the fire won't spread into the building
- A vegetation barrier (pebbles, slabs, or other hard-standing) of at least 500 mm in width shall be installed around of all upstands on the roof (e.g. roof lights) and in front of walls and parapets with low openings
- There must be firebreaks of gravel or concrete strips every 40 m with a width of 1 m, so that even green roofs that are not maintained do not constitute a threat

Based on these instructions, fire safety concerns were no longer an obstacle for the successful development of the green roof market in Germany. The original German fire test is still valid today. As part of the harmonization of European Standards, it is referred to as “Procedure 1” in DIN EN 1187 “Test procedure for the external fire exposure of roofs”.

Testing equipment for test procedure 3: blower, radiant heater and a green roof build-up, initially without vegetation

The fact that not all countries apply this test and that there are three other test procedures available in Europe in addition to “Procedure 1”, formed the basis for further investigations. The idea here is to convince the sceptics of the fire safety of green roofs, in those countries where the “German test” is not used. In the end “Procedure 3” which originates from France was selected for the new green roof test series. This test is considered to be the most stringent as it includes air flow at a speed of 3 m/s from a blower, and radiant heat from a flat radiant heater with a performance of 12.5 kW/m², in addition to the two incendiary agents. The fire testing was carried out in the fire testing facility at the “Forschungsstelle für Brandschutztechnik” at the University of Karlsruhe.

For the tests, 1.2 m x 3.0 m roof build-ups were constructed. They consisted of galvanized, trapezoidal sheet metal profiles, 60 mm thermal insulating boards made of PIR foam with an interlocking profile and a single-layer waterproofing sheet made of thermoplastic polyolefin (TPO). Green roof build-ups (multi-layer system: protection mat / drainage and water storage elements / filter sheet and a 50 mm thick substrate layer) without vegetation were then added to the sub-construction. The tests were carried out in mid-June 2011 at a roof inclination of 5°. First of all, the radiant heater was pre-heated for 3 minutes. Then the two incendiary agents were put in place at the same time. The naked flames of the incendiary agents extinguished after about 10 – 12 minutes. Finally, the build-ups continued to be exposed to radiant heat until the end of the test (test duration without pre-heating 30 minutes in total) and were observed.

Test facility approx. one minute after the two incendiary agents were put in place, fuelled by the airflow from the blower.

The tests showed that the fire neither spread nor burnt through. A substrate surface temperature of about 300 °C was measured some 5 minutes after the end of the test. When the system substrate was removed the temperature measured at the system filter sheet was found to be only 40 °C. No effects of the fire were established from the system filter sheet downwards (including drainage and water storage elements).

No effects of the fire were observed on the filter sheet or the drainage element.

Following the successful completion of the test, the basic set was slightly changed. Given that the original build-up remained virtually unaffected by the preceding fire test, a 1.0 x 2.0 m vegetation mat was placed on it. The mat was pre-cultivated with various sedum types. The fire test was repeated in accordance with Procedure 3, which included incendiary agents, wind and radiation. Once again, the incendiary agents extinguished after about 12 minutes without the vegetation catching fire. During the next 20 minutes, as a result of the radiant heat, the vegetation mat dried out to such an extent that it was possible, after the end of the test, to light this dried-out stretch of about 80 cm diameter using a naked flame. However, the flames extinguished once again after about 2 minutes, without spreading beyond the dried part of the build-up. Even with vegetation, the "fire test" was passed in compliance with the standard test.

Testing equipment for test procedure 3 with a vegetation mat in place

The 30 minute radiant heat led to the vegetation drying out across a diameter of about 80 cm

The results verify that the tested green roof systems with a substrate layer thickness of at least 5 cm and a low amount of organic components can be classified as $B_{ROOF}(t3)$ in line with Part 5 of DIN EN 13501 "Fire classification of building products and construction elements". That means that a green roof build-up would prevent the spread of fire across the roof and the transfer of fire from the roof into the interior of the building, in the case of the roof being exposed to external fire for at least 30 minutes as per the requirements of the test standard. The first green roof systems that passed the test successfully were tested by the ZinCo group, an international pioneer in designing and manufacturing green roof systems.

Even if the different test procedures are not directly comparable, and EU Member States can choose one of them in line with their own national safety standards, exposure in the case of test procedure 3 is particularly severe, as it includes incendiary agents, wind and also radiant heat. This offers the greatest level of protection for the building owner. It will also certainly help to convince the authorities and insurance companies of the safety of green roofing in those countries where there may be no fire protection regulations for green roofs, such as exist in Germany.

Roland Appl, President IGRA

A Case Study from Germany:

Green Roofs and Photovoltaics

The retail warehouse "InCenter" opened in Landsberg/Germany in March 2009. Approximately 18,500 m² of its roof space has been landscaped with an extensive green roof and part of it is being used for a photovoltaic plant which generates more than 800,000 kWh power/year, saving an estimated 470 tons of CO_2 annually. Evaporation from the green roof cools the photovoltaic modules, which in turn increases their efficiency – this is an important contribution to the environment and to climate protection.

Approximately 1/3 of the roof area is covered with 4,264 photovoltaic modules. Special solar base modules held in place by the load of the substrate were used in the elevated solar racking. This provided for a total exclusion of roof membrane penetrations and thermal bridges. The solar base modules not only fulfil their support function for the solar mount, but they also have drainage and water storage function. This both puts the engineering concept in the limelight and allows for an ideal combination of photovoltaics and green roofs.

Noticeable synergy effects: The synergy effects of combining green roofs with photovoltaics are not limited to their installation; they are also noticeable in their operation: solar module efficiency is normally linked to temperatures. As a general rule of thumb, performance sinks by 0.5 % with each degree over 25 °C. Considering that naked roof areas can heat up to over 80°C on hot summer days, but green roofs to only 35 °C, solar modules which are combined with a green roof have a higher level of efficiency. This is a clear financial bonus for the investors!

Apart from the positive effects on the photovoltaic plant, the flourishing green of the 18,500 m² roof area not only fulfils its original environmental function as a rain water retainer, it also acts as an ecological compensation for the newly developed area. This puts InCenter in the limelight thanks to its sustainable and environmentally friendly construction using green roofs and photovoltaics.

Crucial: The distance between panels and substrate surface

Sedum cuttings are used for the plantings

The dimensions of the project are impressive

Singapore:
Heavenly Gardens on Skyrise Architecture

Singapore is impressive with its breathtaking architecture and fascinating roof and facade greenery. Last year this Southeast Asian metropolis was a meeting point for experts – to experience a remarkable conference on green roofs and living walls. Some 500 participants from around the world came to the "International Skyrise Greenery Conference" which was organized by the Centre of Urban Greenery and Ecology (CUGE), the National Parks Board Singapore (NParks) and the International Green Roof Association (IGRA). The experts came to hear about current developments in roof and facade greening, make useful contacts and take part in technical discussions. A highlight of the conference was definitely the excursion to very impressive skyrise greenery edifices in Singapore City.

Hotel Marina Bay Sands – Sky Park

Hotel Marina Bay Sands

Hotel Marina Bay Sands

The recently opened hotel Marina Bay Sands has a 340 meter long roof garden with 250 trees and about 650 container plants on its three 55 storey high towers (totalling 2,561 rooms, including 230 luxury suites). The roof construction of the hotel could be a new record holder, especially considering its 150 meter long swimming pool made out of stainless steel and which holds some 1,440 cubic meters of water. Hotel guests can swim at 200 meters altitude, enjoying a spectacular view over the skyline of Singapore. The outdoor pool is the largest such construction in the world at that height. A further superlative: the Sky Parks observation deck which is built on the northern side of the edifice and projects 67 meters into open space is one of the biggest publicly accessible platforms in the world. Up to 3,900 people can fit on this open high place.

Hotel Marina Bay Sands – Sky Park infinite pool

Gardens by the Bay

Right near the hotel is another large-scale project called "Gardens by the Bay". This is the redevelopment of a whole district to create tropical gardens with integrated 25 to 50 meters high so-called "Supertrees". The "Supertrees" are artificial structures with unique facade greenery and integrated systems to collect rain water. They will also showcase a night lighting system. Singapore's new gardens will also include a wide range of flora to make it a popular city attraction.

Gardens by the Bay – Opening 2012

Marina Barrage: Rain Water Management

Singapore's newest construction for rain water management recently won the "Green Mark Platinum Award for Infrastructure". It is the highest award presented by the Building and Construction Authority (BCA) at its annual ceremony. The intelligent construction offers three benefits in one project: it creates a fresh water reservoir in Singapore to increase water supply. It acts as a flood control scheme to protect lower lying areas of the city from flooding; keeping the water level constant; and it offers a place for water sports in the heart of the city.

The Green Roof Spiral – Marina Barrage

A highlight of the concept is the legendary green roof spiral at Marina Barrage which is both an environmentally friendly drainage system and a form of natural insulation for the building. The distinctive roof garden is the size of four football pitches. A special collection system uses rain water to irrigate the outdoor facility.

Technical Congress with Renowned Experts

On the occasion of the "International Skyrise Greenery Conference 2010" which took place from 1st to 3rd November in Singapore, new technical developments and implementation possibilities for green roofs were presented. Notable green roof and façade greenery experts like Wolfgang Ansel from the International Green Roof Association, Dr. Patrick Blanc from the French National Center for Scientific Research (CNRS), and Professor Dr. Manfred Köhler from the University of Applied Sciences of Neubrandenburg discussed the potential for development of green roofs with architects, planners, constructors and industrial and political decision makers. Dr. Patrick Blanc, in his inimitable fashion and using references from around the globe, promoted the idea of "living walls". With regards to roof greening, the projects presented in Singapore demonstrated a high degree of quality. The currently being constructed project "Gardens by the Bay" with its planned "Supertrees" will serve to make the long trip to the southernmost point of the Asian continent even more worthwhile. Experts, landscape architects, special consultants and scientists from around the world presented their treasure troves of experience in practical workshops. Dr. Michael Henze from the European Landscape Contractors Association (ELCA) gave a lecture on the structure, development and prospects of the landscaping business with green roofing in Europe in mind.

An Ambitious Concept

The upshot is that to create "A City in a Garden" is an ambitious concept for a four million strong city which is expecting to grow by another two million. Given Singapore's existent skyrise architecture, this motto can only be achieved by using variations of skyrise greenery techniques. Clearly popular are the modern designs of the so called "Living Walls".

Dr. Michael Henze
European Landscape Contractors Association (ELCA)

Opening Address by Senior Minister of State, Ms. Grace Fu

Dr. Michael Henze, Elca – The Landscape Gardening Industry in Europe – Focus Roof Gardens

Q & A with Wolfgang Ansel, Patrick Blanc and Prof. Dr. Manfred Köhler

Dr. Ken Yeang: Vertical Greenery and Urban Water Management

Emilio Ambasz: Architecture and Nature – Towards a Pact of Reconcilation

Dr. Tan Puay Yok, National Parks – The Singapore Skyrise Greenery Story

IGRA Award Ceremony in Singapore

On the occasion of the International Skyrise Green Roof Conference the "IGRA Green Roof Leadership Award 2010" was presented to the organization "Friends of the High Line". Although the High Line project might not be recognized as a "Green Roof" at first sight the "elevated urban park" has already set an example. At a height of approx. 10 m the High Line Park connects whole districts above all the traffic and provides splendid views and at the same time recreational space for adults and children. In fact, the High Line Park is a flat green roof (admittedly a very long one) as it has been installed on a waterproofed area without connection to the ground. Many parties have contributed to the success of the project: the architects Diller, Scofidio + Renfro, the landscape architects of James Corner Field Operations, the plant specialists Piet Oudolf, the Green Roof System supplier ZinCo and the installing company Kelco Landscaping, to name only a few. The IGRA-Award 2010 was decided to be given to the „Friends of the High Line" though, firstly as they enabled the realization of this great idea and secondly as they have taken care of financing and maintaining of the project. The latter issue is of great significance for a green roof project. And as the park is very well maintained by the "Friends of the High Line", so far more than 2 million visitors bear in mind the appearance of a successfully landscaped construction. There is no better advertising for green roofs!

Roland Appl, President IGRA (left), presents the IGRA Green Roof Leadership Award to Dr. John H. Alschuler Jr., Chairman Friends of the High Line New York (right)

Greenroofs & Walls of the World™ Virtual Summit 2011

A Greenroofs.com Virtual Conference – held online on September 27th-28th, 2011

The Mission of the Virtual Summit 2011 is to inform, share, and create a global social media experience for learning and networking via the power of the Internet.

In addition to raising awareness of our market and industry, the Greenroofs & Walls of the World™ Virtual Summit 2011 is an interactive platform for the interchange of ideas through a combination of keynote speakers, expert panels, moderated chat sessions with live Q & A, on-demand presentations, plus live video chatting at the Sponsor Meeting Rooms, Networking Lounge, and the spectacular 24-hour Expo Pavilions showcasing vendors and organizations from across the world. Over 50 speakers from around the world are participating in the Virtual Summit including architects, ecologists, landscape architects, engineers, educators, industry CEOs, product manufacturers and suppliers, botanists, non-profit directors, government officials and representatives from the state of New York, cities of Portland, OR; Chicago, IL; and the Bronx. We hope you join us for this very interactive virtual experience – think film festival meets 2-day webinar and online expo extravaganza! Register or learn more by visiting: virtual.greenroofs.com.

Publisher
International Green Roof Association (IGRA)
Office Nuertingen
PO Box 20 25
72610 Nuertingen – Germany
e-mail: info@igra-world.com
phone: +49 (0)7022 7191980
web: www.igra-world.com

Editor
Wolfgang Ansel
ansel@igra-world.com

The International Green Roof Association (IGRA) is a global network for the promotion and dissemination of Green Roof topics and Green Roof technology.