Benefits of Green Roofs and Living Walls

Roof gardens and living walls have been in use in Europe for decades. In fact in some countries it is the law.

Greenery improves the visual and aesthetic aspects of urban areas, is recognized as therapeutic, and helps to remove the effects of pollution, absorbing noise, trapping dust, recycling carbon dioxide, and absorbing and breaking down many gaseous pollutants.

Plants help to reduce the negative climatic effects of urbanization, by absorbing some of the heat generated in city environments, and absorbing the rainfall that otherwise is lost as it runs off hard surfaces.

They can contribute to improved urban climates at the microanalytic scale, and also at the larger scale, by removing the effect of urban heat islands, combat urban flooding, and reduce energy costs associated with keeping building cool in hot climates. Plants can help to regulate the interior climates of buildings by insulating them against extremes of heat and cold, and act like air-conditioning.

In Scandinavia, the soil and grass roofs help reduce heat loss during the long dark winters.
Peat and sod roofs were brought to North America when settlers built homes on the prairies.

Germany is the "green" roof capital of the world, and in fact many laws promote their implementation. By 2002 one in every ten flat-roofed building in the country had a green roof.

In 1980, the Green Programme for Urban Renewal was instituted, giving subsidies for the costs of materials and installation, along with free technical advice, from various city departments.
Berlin took it one step further by requiring that if a new building takes up too much ground space, permission for construction is given only if a green roof is constructed.
Support for green roofs in Germany comes from all government levels, and importance is given to the thickness of the substrate that affect water-holding capacity.
Around 43% of all German cities offer some form of incentive for green-roof installation.
In North America, two cities have established a strong reputation in green-roof implementation: Chicago, Illinois, and Portland Oregon. When soaring heat caused the death of over 740 people. Since then the city of Chicago took measures to become one of the foremost cities in Green roofs.
From the book *Heat Wave* by Eric Klinenberg (http://www.press.uchicago.edu/Misc/Chicago/443213in.html)

Chicago felt tropical, like Fiji or Guam but with an added layer of polluted city air trapping the heat. On the first day of the heat wave, Thursday, July 13, the temperature hit 106 degrees, and the heat index—a combination of heat and humidity that measures the temperature a typical person would feel—rose above 120. For a week, the heat persisted, running between the 90s and low 100s. The night temperatures, in the low to mid-80s, were unusually high and didn’t provide much relief. Chicago’s houses and apartment buildings baked like ovens. Air-conditioning helped, of course, if you were fortunate enough to have it. But many people only had fans and open windows, which just recirculated the hot air.

The city set new records for energy use, which then led to the failure of some power grids—at one point, 49,000 households had no electricity. Many Chicagoans swarmed the city’s beaches, but others took to the fire hydrants. More than 3,000 hydrants around Chicago were opened, causing some neighborhoods to lose water pressure on top of losing electricity. When emergency crews came to seal the hydrants, some people threw bricks and rocks to keep them away.

The heat made the city’s roads buckle. Train rails warped, causing long commuter and freight delays. City workers watered bridges to prevent them from buckling when the plates expanded. Children riding in school buses became so dehydrated and nauseous that they had to be hosed down by the Fire Department. Hundreds of young people were hospitalized with heat-related illnesses. But the elderly, and especially the elderly who lived alone, were most vulnerable to the heat wave.

After about forty-eight hours of continuous exposure to heat, the body’s defenses begin to fail. So by Friday, July 14, thousands of Chicagoans had developed severe heat-related illnesses. Paramedics couldn’t keep up with emergency calls, and city hospitals were overwhelmed. Twenty-three hospitals—most on the South and Southwest Sides—went on bypass status, closing the doors of their emergency rooms to new patients. Some ambulance crews drove around the city for miles looking for an open bed.

Hundreds of victims never made it to a hospital.

The old idea of avoiding roof gardens, especially on older buildings, because of the expected extra weight and stress are debunked with New-style approaches, intensive an extensive.

**Intensive roof greening** is similar to the old-style roof gardens. Soil depth is generally 6 inches deep, but now may be composed of lightweight growing medium.

This new media is known as Substrate. Intensive green roofs are usually covered with lawns or ground covering plants that have thinner substrates and thereby less costly to install.

Substrate depth can be between 0.8 and 6 inches, which reduces the extra loading on the roof. No more heavy soil!

Green roofs are generally called “Ecoroofs”, as a way to distinguish them from other types of roofs that may be also called "green" roofs, because of the use of photovoltaic cells.

Semi-extensive roofs have the same low input philosophy and use the similar lightweight substrates, but have slight deeper layers of growing medium (4-8 in or 10-20 cm) which enables a wider and more diverse range of plants to be grown.

**Benefits of Green Roofs**

There are many incorrect ideas of what a Green Roof is, largely because there hasn’t been enough information about how to make them, and the new ways to make a green roof possible even on older buildings.

Germany has been using Green Roofs for decades but it has only been since the mid 1990's that the work has been translated into English.
Some area of concern are;
- of strengthening the roof to support vegetation and substrates
- the cost of the components of the green roof
- additional construction costs
- getting the material onto the roof
- maintenance.

Components of Green Roofs.
This is not the traditional roof garden in which planting is done in free standing containers and planters. A green roof today, is composed of two layers; the vegetation and the substrate in which the plants are growing. Most will also include a drainage layer.

On older buildings, lightweight systems with substrate depths of 5 - 15cm (2-6 in) will increase the load by between 70 and 170 kg pr. sq. metre (14 - 35 lb pr sq foot). In Ontario roof must be designed to support a loading of at least 195 kg pr. sq. metre (40 lb pr sq ft.) This leaves 88 kg pr. sq metre (22 lbs pr sq ft). spare capacity.

A flat roof with stone chips, can be replaced with an extensive green roof with a substrate depth of 4 cm (1.6 in) which will impose no additional weight.

Advantages of Green Roofs
There are private and public benefits to adding green to roofs.
Private; Savings in energy costs, extension of the life of a roof, aesthetic.
Public; Storm-water management, urban climate mitigation, promotion of biodiversity, and habitat.

Roofs are an enormously underutilized resource in urban areas. Where there is little ground level green space, roofs can be use as the alternative.

With the increase in older residents moving back into denser urban environments, roofs can offer a safe way to cool down, walk, garden and socialize.
The therapeutic effect are known to be considerable including stress reduction, lowering of blood pressure, relief of muscle tension, and increased positive feelings. (Ulrich and Simmons 1986).

Green roofs will last longer than conventional ones with cost benefits.
There is less flooding and leaks of damp penetration to the building.
A major problem with flat roofs is that water tends to pool rather than run off, so there is time for it to seek into any weakness, in the covering.
The substrate and plant layer will hold much of this water, which allows cooling without run off, and no leakage. Plants and soil provide a naturally regeneration protective layer between human traffic and the roof. Maintenance crews often damage surfaces as they walk across.

On man-made hard surfaces (asphalt, concrete) water cannot be absorbed and runs off, through drainage systems, into lakes and rivers. As a result 75% of rainfall is lost to surface runoff. This also means that in built-up areas flooding can result. (This is becoming more common). This leads to over-flow into sewage systems, resulting in contamination of drinking water.
Heating and Cooling

*The insulating effect of green roofs in reducing heating or air-conditioning costs* represents direct economic benefit for the individual building. Reductions of up to 90% can be seen in solar, while indoor temperatures are reduced 3-4 °C (6-8°F) and even lower under green roofs even when outdoor temperatures are between 25 and 30°C (77 - 86°F).

Where air-conditioning is required, reductions in internal temperatures of 0.5°C (1°F) can *reduce electricity use up to 8%.*

In Canada, Environment Canada found that a typical one-storey building in “Toronto with a grass roof and 10 cm (4 in) of substrate resulted in a 25% reduction in cooling needs. Plants with bigger and thicker leaves adds more cooling effect.

Pollution

Particulate matter, from vehicles (especially diesel) has been linked to respiratory disease. Vegetation can filter out fine airborne particles as the air passes over plants. Lead, zinc, and copper, cadmium, uses in construction of buildings, give off salts which contaminate water supplies. Plants help in dissolving these salts.

Heat Island Effects

Large areas of hard surfaces hold heat through the night which doesn't allow for natural cooling. These surfaces can keep temperatures 10°C higher than normal. This urban heat also causes increases in convection currents that generate more rainfall over cities which are more violent.

These convection currents generated by hot surfaces have the strength to raise dust, adding to atmospheric pollution.

Urban vegetation has the power to increase evapotranspiration achieving a general cooling effect. The larger the individual green areas, the greater the range of temperature moderation.

Noise Pollution

Hard surfaces reflect sound. Green roofs can absorb sound. A green roof with 12 cm (4.8 in) substrate layer can reduce sound by 40 dB.

Fire Prevention

Green roofs can help slow the spread of a fire.

Conclusions

Direct and indirect job creation; 1350 person years.
Reduction in the urban heat island of 1-2°C (2-4°F)
Annual greenhouse gas emission reductions of 1.56 megatonnes (1714 tons)
Reduction in the number of smog incidents by 5 - 10%
Amount of particulate Matter captured by plants; 30 tonnes per year.
Storm-water retention capability; over 3.6 million cubic metres per year. Storm-water retention capability; over 3.6 million cubic metres per year.
Annual energy cost savings; more than $1 million per year

Source - Planting Green Roofs and Living Walls (Nigel Dunnett and Noel Kingsbury)
URL LIST FOR GREEN ROOFS AND LIVING WALLS

Next Green roof conference
world green roof congress

CI RIA in partnership with Livingroofs.org is pleased to announce the 2008 World Green Roof Congress, to be held in London on the 17-18th September. This is the first event of its kind to showcase green roofs in the UK. The normally biannual World Green Roof Congress brings together leading green roof experts providing a platform for the latest research, policy initiatives and practical case studies. This exciting and respected Congress will drive the uptake and implementation of green roofs, provide a greater level of understanding of their benefits and stimulate innovation: shifting the perception of green roofs from the quirky to the main stream and demonstrate the business case.

http://www.greenroofs.com/#WorldGreenRoofCongress

http://www.greenroofs.com/tv.htm

Video on YouTube Cradel to Grave
http://www.youtube.com/watch?v=IoRjz8iTVoo

http://www.g-sky.com/GWC_Overview.aspx

http://www.g-sky.com/Benefits/Default.aspx

Price List here
http://www.g-sky.com/GreenWall_Prices.aspx

Feasibility study - Queens University
http://www.queensu.ca/pps/reports/greenroof.pdf

Feasibility Study - Uni of Waterloo

ELT - Burlington/ Brantford
http://www.eltgreenroofs.com/

Toronto - Green roofs for Healthy Cities
http://www.greenroofs.org/index.php?option=com_content&task=blogcategory&id=18&Itemid=66
- lots of links on this page.

Green Roofs Magazine

City of Toronto wins award for Green Roof Strategy
http://www.toronto.ca/greenroofs/

City of Toronto.
sustainablecity@toronto.ca.

http://www.freepublictransit.org/index.php?pr=Autosprawl -

http://www.conferenceboard.ca/knowledge.htm - upcoming conferences

http://www.dcnon.com/articles

http://www.city.waterloo.on.ca

www.mekarch.ca

www.gardensinthesky.ca

http://www.windmilldevelopments.com/resources_links.html

http://thegreenpages.ca/portal/on/sustainable-communities/

Climate Wire Magazine
http://www.rtcc.org/2008/html/

http://www.creativecity.ca/resources/making-the-case/urban-renewal-2.html

http://www.jetsongreen.com/2008/05/green-roof-awar.html

Green Roof Solutions
http://tremcoroofing.com/greenroofing.asp