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What It Means To Be Green

Green Roofs Offer A Healthier Option

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The environmental and health problems commonly associated with air pollution, noise pollution, storm water runoff, and groundwater pollution are often experienced with greater frequency and greater intensity in urban and more densely populated areas. The vast areas of paved streets, concrete sidewalks and acres of (usually black) rooftops in most cities act as a giant heat sink and create what is referred to as a "heat island effect" which can account for temperatures in urban areas being as much as 10ºF higher than in surrounding suburban and undeveloped areas. The resulting microclimates lead to increased cooling loads in the summer, requiring larger HVAC equipment and electrical demand which creates more greenhouse gas, pollution and energy consumption. In any community that is trying to address the dangers posed by one or more of these issues, the solution, in part, may be as close as the roof over our heads. That is, if it's a green roof.

Green roofs are simply roofs that have been planted with vegetation. These living roofs, also known as eco-roofs, rooftop gardens, or living roofs have been in use for thousands of years. The Hanging Gardens of Babylon, considered one of the wonders of the ancient world represent an early and noteworthy case in point. More widespread examples were in the form of thatched or sod covered roofs which are still prevalent in some regions of the world. When the first predecessors to today's skyscrapers began to emerge on the urban landscape in the late 1800's, rooftop gardens began to appear on such notable buildings as New York City's Waldorf-Astoria Hotel. Despite its early origins, the revival of the green roof and the technology that is being employed today began in Germany in the early 1970's. Today, more than 14% of all rooftops in Germany have been "greened" and future green roof construction is encouraged through tax incentives.

Green roofs offer a variety of environmental benefits. They have proven to be effective in contributing to storm water management. The permeable surface is capable of absorbing and retaining water, much of which is released back into the atmosphere through evapotranspiration (evaporation of water particles from the plant surface) and the rest of which is slowly released into the ground. An extensive (low-profile) green roof can absorb about 70% of the rainwater it receives. Data gathered from a green roof in Philadelphia measured a runoff reduction of between 50 and 60%. The Bureau of Environmental Services reported results from testing a 4" thick green roof in Portland, OR indicating that it was capable of absorbing a full inch of rainfall during a summer rain event. A 1999 report to the NYC Department of Environmental Protection stated that vegetated rooftops may have significant feasibility as an alternative to tank storage technologies in certain areas.

In addition to its capacity for storm water retention, a green roof can also contribute to pollutant removal by its ability to filter particulates such as nitrogen and phosphorus out of the rain water. Microorganisms in the soil break down many of the pollutants while other pollutants such as the heavy metals bind themselves to the soil particles.

In one case study, the roof temperature of a conventional flat roof was recorded at 90ºF

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while the temperature beneath the planting media on an adjacent area of green roof measured 60ºF. Considering that a 3-7ºF temperature drop can reduce air conditioning requirements by 10%, a green roof on a one story building could reduce cooling costs by up to 30%. Green roofs can become a major contributing factor in reducing the heat island effect in urban areas. It is worth noting that the lower surface temperature under the green roof was mostly due to the fact that the roof surface was shaded and not exposed to direct sunlight and not due to insulating properties of the green roof components. Green roofs are not as effective at reducing heat loss during the colder months and roof assemblies should be insulated accordingly.

Another benefit of a green roof is its sound attenuation capacity. Some reports indicate that a green roof with 5" of soil will reduce sound transmission by 40dB while an 8" thick green roof will approach a 46-50dB reduction. Where noise control is a concern such as in busy urban settings or near airports green roofs may be part of the design solution.

The creation of wildlife habitat is another reason to consider a green roof. In areas where green space is in short supply, or in developments where open space has been replaced with buildings or paved areas, a green roof can begin to offset the site disturbance that results from any construction project. The proper selection of native plants can contribute to a habitat restoration or improvement effort.

The design and construction of green roofs typically falls into one of two basic categories: extensive (low-profile) and intensive (high-profile). An extensive green roof is a relatively light weight and less expensive system that requires less maintenance than an intensive system. About 2½" to 6" of growing medium is necessary for an extensive green roof and little to no additional irrigation beyond normal precipitation is required. These roof meadows, as they are also called, typically contain plants like sedums, grasses and wildflowers all of which can thrive in a shallow root base with limited water and nutrients. Generally, these roofs are not designed as outdoor spaces for people, but as green spaces that provide several environmental benefits. Although these systems can sometimes be installed on existing flat or low sloped roof structures, the load bearing capacity of the existing roof structure should be evaluated first.

An intensive green roof which can also be used as a true roof garden where people may gather is a much heavier and more costly system which requires more maintenance and a structural roof assembly designed to carry the additional loads. These roof systems may have 8" to several feet of growing medium and can accommodate a wide variety of vegetation including grasses, shrubs and even small trees. Irrigation needs are often greater than for an extensive green roof although plant selection can play a key role in determining watering demand.

The cost of an extensive (low-profile) green roof is in the $10 - $20 per square foot range depending largely on the soil depth and choice of vegetation. A redevelopment of the Ford Motors complex in Dearborn, MI includes a green roof that covers nearly 11 acres of rooftop and serves to purify storm water and provide natural air conditioning.

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The $13 million cost for this living roof was a bargain compared to the more conventional storm water management construction alternative involving concrete pipes and chemical treatment plants at a cost of $48 million. Aside from the obvious cost savings, this green roof provided a habitat for wildlife almost immediately.

The benefits are numerous, but, as with some green building options, there is a higher first cost for the roof than for a conventional roof. However, the soil and plantings will protect the roofing membrane from damage and may increase its operating life by 2 to 4 times. Some estimates claim that the payback period is somewhere between 5 and 7 years. Energy savings on cooling costs can be dramatic. A life cycle cost analysis can demonstrate the value of investing in a green roof. With the proven potential for reduced energy consumption, a reduction in the heat island effect, cleaner water recharging our aquifers, better storm water management plans, cleaner air, and wildlife habitat restoration, clearly, the value is far more than financial.

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