What Makes A Roof Green?

by Jason F. McLennan and Peter Rumsey

Roofs have represented the essence of shelter since the first lean-to was put up against the rain. As structures evolved, roofing form and function also expanded. Modern roofing design considers longevity, aesthetics, insulation and HVAC systems, yet the priority remains protection from the elements. Green design explores newer factors, including daylighting, energy efficiency, urban heat island effects, and site hydrology and ecology.

The term "green roofs" has come to refer to vegetated systems for flat or low-sloping roofs. Typically they are comprised of plants in soil or another growing medium on a waterproof membrane, often with drainage and fabric filter systems, and might include irrigation, insulation, and root and wind barriers. Green roofs cover 150 million square feet in Europe and are gaining popularity in North America. In general we support this technology, but like anything we review, the two of us have an opinion! Vegetated systems can greatly lower site and roof ambient temperature, reduce runoff, purify air, provide habitat, extend roof life, reduce operating costs, visually blend a structure into its environs and create a pleasing space for visitors. Green roofs might help earn points in several Leadership in Energy and Environmental Design (LEED) rating system credit areas, including storm water management, urban heat islands, and possibly innovation in design and regional or recycled materials.

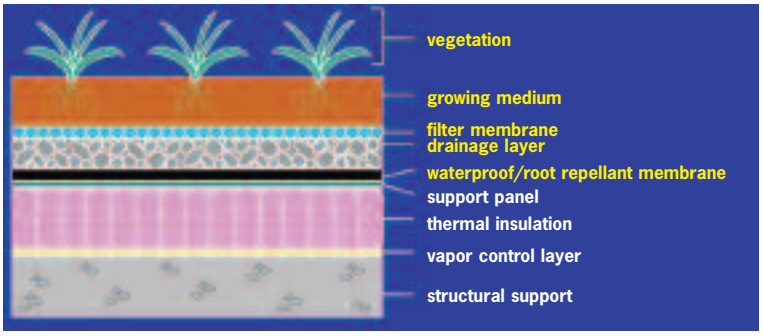

Diagram courtesy of The Cardinal Group Inc.

However, green roofs can be complex and expensive, requiring investments of time and effort to establish stable plant communities. They can be heavy, and roof load-bearing capacity is a factor. The use of nursery plants and lighter, modular designs might help address some of these challenges.

In many ways a vegetated roof is becoming an 'icon' for green buildings. But be wary of icons and standardized features. A green roof does not necessarily mean that the building is green! Buildings must be judged on overall performance, not the mere presence of a certain feature. No single technology is a perfect fit in every case. Limited roof space should be used to best serve the building's purpose and function, depending on the climate and site. There is more to green roofing than putting gardens on buildings. For example, skylights or clerestories that balance heat gain and light can save energy and boost occupant productivity or retail sales. Depending on the design, the daylight apertures might not leave much room for plants, yet this design might be more beneficial than a garden covering the entire roof.

Evaluate Sustainable Options

In certain climates, a green roof might not be appropriate if the system required water to keep the green roof alive. In places like Phoenix, Ariz., where water conservation is more relevant than storm water management, highly reflective "cool roof" coatings or photovoltaics might be optimal roofing choices. Vegetated roofs might be the most "green" option in cool, rainy areas such as Seattle, but radiative cooling systems might offer more energy and environmental benefits in cooler, drier areas. Any technology needs to be evaluated based on its suitability to the climate and building function.

The greatest O&M cost savings accrue in climates with rainfall and temperature ranges that naturally support plantings of native species with little maintenance, and the system extends roof life by reducing temperature. These factors suggest that good green roof candidates include buildings in areas of high-density development where storm water management and urban heat island issues are particularly important. Visibility and public access are also beneficial.

Sustainable design is a balancing act, involving trade-offs among the cost and benefits of the suite of potential features. In one project we've seen, a large industrial building featured an extensive green roof, but neglected more cost-effective improvements to the cooling system that would have provided greater energy performance benefits. Perhaps a different system should have been used. And yet, tens of thousands of square feet of plants provided a more

obvious symbol of green design intent than would have any number of less visually compelling but more efficient pumps. Prominent features such as roof gardens and photovoltaics might not yield the biggest bang per buck in avoided costs, but they have significant educational value about green design with the public, who are more likely to "get it" when they see it.

In summary, there is no boilerplate solution to what makes a roof green. The selection should be dependent on what technology will result in the best mix of environmental performance, durability, cost, aesthetics and protection from the elements tailored to climate and building function. **EDC**

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Note: "The Green Edge" is a new *ED+C* column by architectural designer Jason F. McLennan and engineer Peter Rumsey, P.E., CEM. The team will share their perspectives on the methods, trends and challenges of the green design movement that is transforming the construction industry. McLennan and Rumsey will examine some of the pitfalls of current design practices and offer practical insights for successful projects. Look for future columns that will address such issues as improved design team collaboration, how to earn LEED credit points and selling green features to clients that don't ask for them.

See also "Design of Rooftop Gardens" in the *Cool Roofing* supplement on page 16s.