Feature

ROOFTOP OASES

LONG CULTIVATED BY NORTHERN CULTURES FOR THEIR THERMAL BENEFITS, GREEN ROOFS ARE SPROUTING UP IN EUROPE AND THE UNITED STATES AS A SUSTAINABLE STRATEGY THAT ADDRESSES AESTHETIC, ENERGY AND STORM-WATER ISSUES *By Jane King Hession, Assoc. AIA*

Think back to the last time you were looking out an upper-floor window of a tall building (any tall building) in a city (any city). What did you see? Chances are it was acres of uninhabited flat, asphalt rooftops that radiate heat in summer and are frozen barren islands in winter. Now imagine the same view but with acres of "green roofs"—roofs covered in sod or native grasses, landscaped with flowers and trees, dotted with paths and benches, inhabited by butterflies, birds and people. Not only is the view more aesthetically pleasing, it is alive with a new ecology that thrives in a once forgotten realm of the city.

Today, green roofs are becoming more than just an exercise in imagination. They're beginning to appear in many American cities and not simply because they are beautiful. Green roofs are a sustainable-architecture tool that addresses serious air, water and pollution issues facing urban centers today.

Roofing a structure with a layer of vegetation is not a new idea. The Hanging Gardens of Babylon (c. 600 B.C.) were described by one Greek historian as having "plants cultivated above ground level and the roots of the trees are embedded in an upper terrace rather than in the earth." Although Nebuchadnezzar II reputedly constructed the gardens to recreate a distant mountain landscape for his nostalgic wife, other cultures built green roofs for more practical reasons.

Early Icelandic structures featured roofs of sod and turf because wood was scarce and vegetative

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David Salmela, FAIA, introduced green roofs to Ravenwood (above) that harken back to Finnish building traditions and help the building blend into its wilderness site.

roofs provided a relatively good layer of protection and insulation. These prevalent green roofs became a hallmark of Icelandic vernacular architecture and many examples, including the recently restored 9th-century home of Erik the Red, still stand in rural Iceland today.

The feasibility of green roofs in more urban settings, however, has always been problematic. Throughout history, many architects explored the idea of incorporating green spaces into their designs, including LeCorbusier, who favored roof gardens. Although most cities boast a few elegant rooftop gardens, for the most part green roofs never caught on as a standard building practice. The technologies needed to address the complex technical, structural and hydrologic challenges of building and maintaining a green space on top of a building did not exist.

It wasn't until the environmental movement of the 1970s that green roofs were first considered from an ecological point of view. Yet despite a rash of earth-sheltered structures of the period, such buildings did not find favor with either the architectural community or the general public, primarily because the cost and technical challenges of green roofs seemed to far outweigh any environmental positives.

Modern green-roof technology began in Germany more than 30 years ago and Germany remains a leader in the field today. Early on, the Germans grasped the positive environmental impact and energy-saving potential of green roofs. According to one expert, the Germans "believe it is part of their duty, just as recycling is, to use as little energy as possible." Nearly half of all German cities have zoning, regulatory measures or financial incentives in place to encourage or mandate the inclusion of green roofs on existing and new construction, which in turn is supported by a burgeoning green-roof-manufacturing and -construction industry.

North American cities, by comparison, are newcomers to the green-roof technology arena. Few offer any economic incentives or have any regulatory measures in place. Recently, however, several cities have built high-profile green-roof projects, including a 33,000-square-foot Heat Island Initiative on top of Chicago City Hall; the Green Roof Infrastructure Demonstration Project atop Toronto's city hall; and Pittsburgh's Heinz 57 Center's 12,000-square-foot roof garden, which wraps around the 14th-floor penthouse office space.

There are two basic categories of green roofs: intensive and extensive. Intensive green roofs—which require deeper soil, artificial irrigation and

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Early Icelandic structures featured roofs of sod and turf (top, above), which have become hallmarks of Icelandic vernacular architecture.

intensive management, and are often intended as landscapes or gardens for people—are heavier systems that can have structural implications for a building. Extensive green roofs require only a thin layer of soil, no artificial irrigation and little management. Often planted with sods or grasses, extensive green roofs are useful in reducing the environmental impact of a building and in creating habitats.

In either case, the basic components of a green-roof system consist of layers of vapor barrier, thermal insulation and waterproof root-repellant membrane over the structural support followed by layers of drainage material, filtering membrane, growing medium and vegetation.

Sometimes a green roof is easy to spot. Especially when someone is mowing it. A good example can be seen on the Minneapolis garage designed by Jim Nestingen, who is of Norwegian ancestry and was inspired by the ancient building tradition of the *torvtak*, or sod roof, he had studied on a trip to Norway. In 1998, he designed an addition to his garage that he covered with a green-roof system. It also functions as an extension of the family's backyard.

With one gesture, "I doubled the size of both my garage and my yard," Nestingen claims. The roof remains an object of curiosity for many. Nestingen recalls the day a fire truck pulled up in front of his house. He was both relieved and amused to discover the fire fighters had come only to see the green roof. "They even climbed up on it," he adds.

David Salmela, FAIA, Salmela Architect, Duluth, traces some of his interest in green roofs to Finnish-vernacular building traditions of northern Minnesota, specifically the birch-, sod- and grass-covered structures on and near his father's farm. But his motivation for incorporating green roofs into his design of Ravenwood Studio in Ely, for *National Geographic* photographer Jim Brandenburg, was logical problem solving. (See *Architecture Minnesota*, May–June 1998.)

For Brandenburg, the architect designed a compound of structures at the edge of wilderness that built upon existing structures on site, including a log cabin. The challenge was to link the pieces. Salmela realized that a simple flat-roofed structure could facilitate the connection yet not overwhelm the log cabin. He opted to cover the roof with sod because it was sensitive to the wilderness surroundings, referenced the cultural traditions of the region and was aesthetically pleasing. Although he contends that "we need nostalgia and things that have a softness to them in architecture," in this instance a green roof afforded "the simplest solution to a complex situation."

Sometimes a green roof looks like an urban park. Consider Marquette Plaza (designed as the Federal Reserve Building by Gunnar Birketts in 1973) on the north end of Nicollet Mall in Minneapolis. As originally designed, the extensive granite-paved plaza in front of the building functioned as little more than a haven for skateboarders. When FRM Associates, Minneapolis, redeveloped the long-troubled building, they entered into a partnership with the City of Minneapolis to redesign the hard-surface plaza into the only public park in downtown Minneapolis (see *Architecture Minnesota*, November-December 2002).

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The park is actually a green roof covering office space and a parking ramp below. "The building was built as bomb-proof," says park designer Gary Lampman, landscape architect, Walsh Bishop Associates, Inc., Minneapolis. "The weight of the granite pavers was taken into account in the original structural design." Therefore, once the granite was removed, he continues, the structure was "able to accommodate the substantial soil load necessary to anchor plants and trees."

The pleasing appearance and inviting nature of green roofs belie the fact that they are environmental workhorses. Their public benefits are enormous: They improve air quality and reduce smog by filtering airborne particulates; they promote carbon dioxide/oxygen exchange; they mitigate the urban-heat-island effect and noticeably affect a building's heat gain and loss, and they are remarkably effective as storm-water-retention devices.

Consider Minneapolis's Phillips Eco-Enterprise Center (PEEC), one of the nation's first comprehensive green buildings and business centers, developed by the Green Institute and designed by LHB Engineers and Architects, Minneapolis. One of the environmental design goals of PEEC is that the building play an active role in the protection and conservation of water resources. The most serious threat to be addressed is combined sewer overflows (CSO) that occur during heavy rainfalls when storm-water runoff floods the sanitary sewer system and raw sewage enters the Mississippi River in violation of federal law.

Green roofs can help mitigate this problem because they decrease, retard and filter storm-water runoff. According to Michael Krause, executive director, the Green Institute, "green roofs are [becoming] increasingly important to private developers because of new fees that are likely to be charged based on a project's impact on the storm-water system."

The green roof planned for PEEC, which will be clearly visible from the Hiawatha LRT line as it passes over East Lake Street, is one strategy toward attaining the goal of managing 100 percent of the center's storm water. Krause adds that integrating a green roof in an office/light-industrial building complex has been "a real selling point for prospective tenants. The paybacks will only increase over time."

As will the number of Minnesota architects and landscape architects-in-training familiar with green-roof technology, thanks to a demonstration project underway at the College of Architecture and Landscape Architecture (CALA), University of Minnesota. According to Peter MacDonagh, adjunct faculty member, CALA, and a landscape architect with the Kestrel Design Group, Inc., Edina, half of the 900-square-foot roof surface on an entry canopy at CALA's Ralph Rapson Hall will soon be covered with conventional roofing material and the other half in a extensive green-roof system.

Rainfall, runoff and temperature will be monitored and compared for five years. MacDonagh is confident that data gathered will support other positive green-roof research to date, but additionally will provide a convincing "local example" that will lead to greater green-roof use in the Twin Cities and on campus. Optimistically, he adds, "the university's administrative offices are just across the way on an upper floor," with a view to the roof. "We hope they notice."

As rendered in this computer-generated image (top), the green roof planned for PEEC will replace asphalt (above) with plants for storm-water retention and seating areas for employees.