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Technical Article

Cleasby Manufacturing Inc.

Understanding the Basics An Introduction to Green Roofing

by Karen and John Cleasby, Western Roofing Magazine, May/June 2007

(Editor's Note: Karen and John Cleasby are a brother and sister team whom represent Cleasby Manufacturing's third generation of Cleasby's. Together, they share over 37 years of experience working at the manufacturing level. Product development, technical support, safety training, sales and marketing are just a few of the responsibilities they share. John or Karen may be reached at (800) 253-2729.)

Green roofing, as a roofing methodology, is not common and is loosely defined, but due to a rapidly growing concern for and need to find ways to help sustain our planet, there is a renewed interest and push for this ancient technology.

A Brief History

"Green roofs" or "sod" roofs (a term used in a former incarnation), aren't new and date back to 600 B.C. with the historic Hanging Gardens of Babylon, considered to be one of the seven great wonders of our world. "The Hanging Gardens have plants cultivated above ground level, and the roots of the trees are embedded in an upper terrace rather than in the earth. The whole mass is supported on stone columns... Streams of water emerging from elevated sources flow down sloping channels... These waters irrigate the whole garden saturating the roots of plants and keeping the whole area moist. Hence, the grass is permanently green and the leaves of trees grow firmly attached to supple branches... This is a work of art of royal luxury and its most striking feature is that the labor of cultivation is suspended above the heads of the spectators," according to descriptions derived from ancient Greek sources.

A Definition

Though green roofs aren't theoretically new, the development of the contemporary green roofing system is, which by definition, in its basic form, is a system of manufactured layers deliberately placed over the roof to support growing medium and vegetation.

These modern day green roofs were first developed in Germany in the 1960's, and have since spread to many countries in Europe. North America, although slower to catch on, is gaining momentum in the development of "green roof technology," and has seen a 25% rise in green roofing in 2006 with over 100% growth specifically in the intensive green roof garden market, according to a survey conducted by Green Roofs for Healthy Cities, the North American Green Roof Industry Association.

There are two types of green roofs - intensive and extensive. Deciding between the two is determined by the structural capacity and integrity of the building, and the goal of the project.

Intensive green roofs are considered traditional-style roof gardens with large trees and shrubs. They are often accessible to the public and can include garden paths, seating, and other features that make the roof an outdoor room. Since they are meant to be similar to a park, they generally are on flat roofs. As suggested by the name, intensive garden roofs are labor-intensive, requiring irrigation, feeding, and continuous main-

tenance. “Intensive roofs are multi-layer constructions, typically installed over concrete roof decks. They require substantial structural capacity: approximately 8” to 4’ of soil depth, and support of roof weight loads from 80 to 150 pounds per square foot.”¹ We also found that depending upon the manufacturer of the green roof system installed, the recommendations can vary. For instance, Hydrotech’s Garden Roof Assembly® is a lightweight system with specifications allowing for 6” to 3’ of soil depth or growing medium, and a structure capable of supporting a roof weight load of 50 to 78 pounds per square foot.

Extensive green roofs, unlike the intensive roofs, are designed to be virtually self-sustaining requiring minimal maintenance. These roofs also benefit the environment, “...by mitigating the effects of urbanization on water quality by filtering, absorbing, or detaining rainfall. Extensive green roofs can have a soil depth of approximately 1” to 7” and can carry weight loads of 15 pounds per square foot. They are constructed of a lightweight soil medium and are underlain by a drainage layer and a high quality impermeable membrane that protects the building structure. Extensive green roofs can be installed over various roof decks; however, a structural engineer should always first inspect the structure to determine its weight load limitations.”²

Composition of a Green Roof

Whether intensive or extensive, a waterproofing membrane is used as the first layer and depending upon the material manufacturers recommendations, can be applied directly to the roof deck. The generic name of this waterproofing membrane is “hot melt rubberized asphalt.” There are systems that suggest applying a primer to the deck first to help material adhesion. In some cases, it is a matter of compliance and must be done.

A few of the required and optional proceeding layers of the system may include a root barrier to protect the waterproofing membrane from root penetration, a layer of moisture resistant insulation such as Dow StyroFoam®, and a drainage/water retention layer like Hydrotech’s FD40 or FD60 patented, three dimensional, 100% recycled polyethylene panels. These panels provide water storage, drainage, and aeration for substrate soil and can include a moisture mat that lays under the trays for added water retention.

When a green roof is put out to bid, the roofing contractor is asked to bid on one or more layers of the system, sometimes even the entire system. But more commonly a roofing contractor, trained in the art of green roof installation, will install the non-living components (e.g. vapor barrier, waterproof membrane, root barrier). Landscape architects and contractors typically design the green roof and install the living components of the system.

Equipment Needs

In keeping with our area of expertise, let’s address the equipment used to heat rubberized asphalt. Both material and equipment manufacturers stress the importance of using a kettle designed solely for the purpose of heating this sensitive material which, depending upon the brand, is a composite of materials that may include asphalt, synthetic rubber, and a filler such as clay, and not to use a traditional roofing kettle. Roofing kettles are tube fired putting the material directly up against the heating source. Direct exposure to the heat will burn rubberized asphalt. These kettles are also not equipped with the required agitators needed to continually mix the material, keeping all material components well blended, and to help maintain a consistent temperature throughout the vat. The agitator also keeps the material from burning and turning into carbon. Finally, roofing kettles operate at consistently higher temperatures that are detrimental to the rubberized material.

Indirect heating units, air-jacket and oil-jacket kettles, are designed specifically to heat hot applied rubberized asphalt and if used according to the manufacturer’s instructions, will not damage or change the composition of the material. Air-jacket or oil-jacket kettles equipped with full-sweep agitators whether hydraulic, electric, or manual are best suited for heating rubberized asphalt. Powered agitators are recommended because they are less labor intensive and offer uninterrupted agitation.

The air-jacket kettles, the most popular units for this application because of the speed in which they heat the material, are bottom fired with a burner that is housed within the air jacket chamber. The burner heats the air-chamber which surrounds the material vat on three sides. The heated air-chamber in-turn warms the material.

Oil-jacket kettles, by contrast, are tube-fired with the tubes completely submerged in a heat transfer oil chamber. The warmed oil slowly heats the material keeping it from burning. These units also help the material retain heat longer. With regards to the use of heat transfer oil and the environment, the oil can be used repeatedly as long as it does not become contaminated with water or other foreign matter. As a manufacturer of oil-jacket kettles, we

recommend changing the oil annually if the unit is used on a regular basis to avoid contamination problems.

Tim Blue, Blue's Roofing, San Jose, Calif., one of a handful of approved Hydrotech installers in Northern California and one of the most experienced, prefers the air-jacket kettle because it heats up faster and weighs less on the roof. Oil can add up to 780 additional pounds to the deck load when on the roof.

Once the material is adequately heated, approximately 400°F depending upon the material manufacturer's instructions, it is dispensed into buckets, preferably insulated buckets and hauled to the point of application. Squeegees and standard paint rollers are used to apply the material.

Why A Green Roof

Aesthetics aside (they are visually more appealing), green roofs conserve energy by improving thermal performance; in the winter they provide an insulation barrier by reducing heat loss from buildings, and in the summer they reduce the amount of solar energy absorbed by the roof which helps keep buildings cooler. This in turn helps combat the urban heat island effect. "Traditional building materials soak up the sun's radiation and reflect it back as heat, making cities at least 7°F hotter than surrounding areas."³ Green roofs can also be used to manage storm water runoff that would normally carry soil, pesticides, fertilizers, oil, litter, and other pollutants into nearby ecosystems. Improved air quality is another added benefit. Plants take in carbon dioxide from the atmosphere and produce oxygen. They also extend the life of the roof by protecting the membrane from climatic extremes and physical abuse.

The Economics

A green roof can last two to three times as long as a traditional roof. The cost though, is higher, sometimes significantly, than a traditional roof. "Cost per square foot depends on many factors: The size and slope of the roof, depth and complexity of the system, height and accessibility from the ground, cost of labor, and need for specialized elements, such as drains, railings, pavers, slope stabilization measures, etc."⁴

Whether green roofing is merely a timely trend or the beginnings of a new way of building and living within our communities for years to come, one thing is certain, it isn't going away anytime soon. With cities like Chicago and Washington D.C. at the forefront of this rapidly growing market, boasting more total square feet of green roofing installed than anywhere else in the United States, other cities are taking note. Currently, San Francisco is home to ten pilot "green building projects" including the world's largest public green building.

1 An excerpt from Green Roofs in Urban Landscapes, written by Eva Worden, Diana Guidry, Annabel Alonso Ng, and Alex Schore, from the University of Florida IFAS Extension.

2 An excerpt from Green Roofs in Urban Landscapes, written by Eva Worden, Diana Guidry, Annabel Alonso Ng, and Alex Schore, from the University of Florida IFAS Extension.

3 An excerpt from History and Uses of Green Roofs, <http://en.wikipedia.org>.

4 An excerpt from Roofscapes Inc., <http://www.roofmeadow.com/faq/faq.shtml>