UF UNIVERSITY of FLORIDA
IFAS Extension

Green Roofs/Eco-roofs

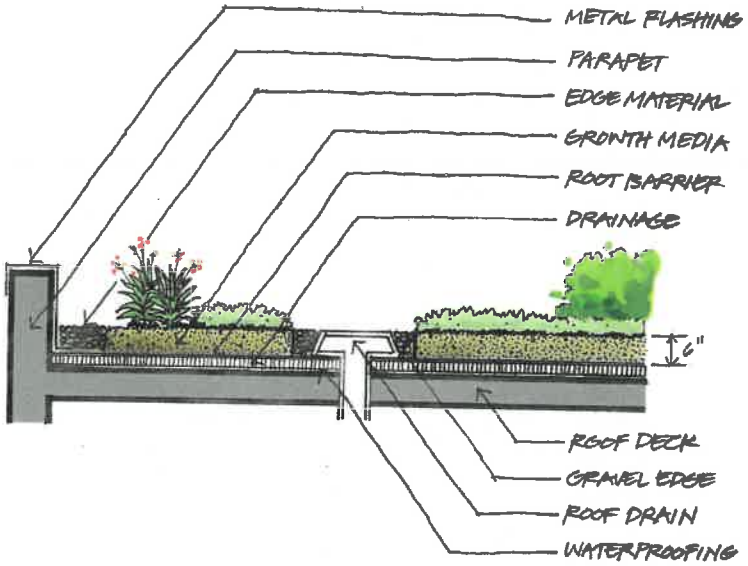


Diagram illustrates layered components of a typical green roof.

Definition:

A green roof or eco-roof is a planted roof top that provides benefits of water harvesting, stormwater management, energy conservation, pollution abatement, and aesthetic value.

Green roofs vary in depth of growing media, types of plants (climate-dependent), infrastructure, and intended use.

Objectives:

Green roofs reduce total stormwater runoff volume and peak flows, improve building insulation properties (reducing heat island effects), and extend the expected life of the roof's base material.

Applications

- Commercial buildings
- Industrial buildings
- Residential buildings

Overview:

Green roofs are generally categorized into two types: extensive and intensive. Extensive green roofs have a shallow (<6" depth) growing media and are light-weight structures (approximately 10-35 lbs./sq.ft. when wet) that cover large expanses of rooftop, requiring minimal maintenance. Intensive green roofs, or "rooftop gardens," use deeper growing media (>6") and can include small trees and shrubs, creating park-like settings that are more accessible. They tend to be more expensive and their heavier weight on the roof (approx. 50-300 lbs./sq.ft. when wet) must be considered in the design. Intensive green roofs are more common in tropical climates than extensive green roofs.

Examples of Florida applications of green roofs include: a 2400 ft² storage facility in the Bonita Bay Group's master-planned community Shadow Wood Preserve (Lee County); the University of Central Florida Student Union roof (1600 ft²); and the University of Florida Charles R. Perry Construction Yard roof (2600 ft²) in Gainesville. The University of Central Florida has monitored pollutants in roof filtrate water on a green roof designed for stormwater treatment and found that the green roof effectively reduced pollutants, including nitrate and ammonia, relative to a conventional roof.

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Benefits

- Reduces stormwater volume (50% to 85%)
- Improves stormwater quality through load reduction
- Saves water by harvesting rain
- Reduces heat island effect
- Lowers surface temperatures by 40°-50° F
- Energy savings can reach 15%-30%
- Reduces noise for building occupants
- Increases the life of the roof and reduces roof maintenance costs
- Contributes to biodiversity and creates habitats for birds and invertebrates
- Filters air pollutants and captures airborne particles

Water Protection Benefits:

Water conservation implications – When used in conjunction with cisterns for stormwater management, green roofs can allow for more consistent capture and provision of harvested rainwater, with the potential to indirectly reduce potable water demands for landscape irrigation.

Stormwater implications – By intercepting, retaining, detaining, and filtering rainwater at the beginning of the stormwater treatment train, green roofs can play an important role in source control stormwater management, reducing stress on downstream treatment systems.

Design Keys

- Infrastructure
- Type of growing media
- Depth of growing media
- Species of plants
- Rainwater collection
- Irrigation
- Intended purpose

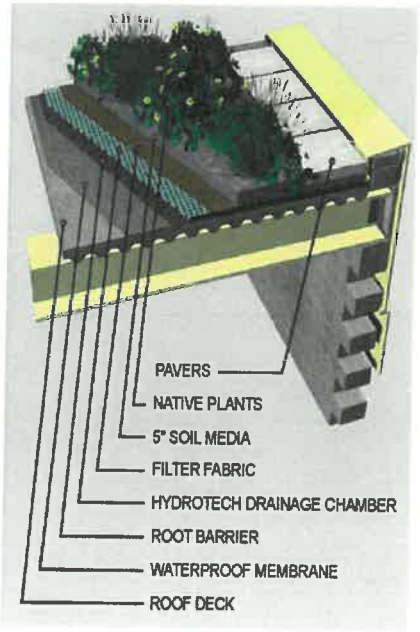
Design Considerations:

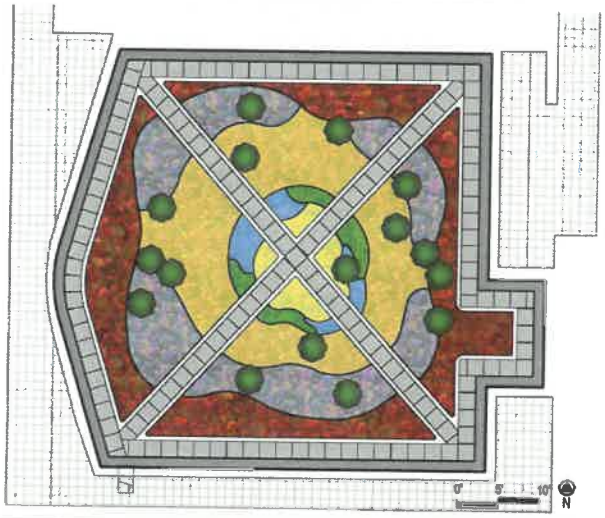
Green roofs function independent of the infiltration capacity of the site soils and can be applied to residential buildings, although they are most appropriate for commercial and industrial use. Extensive and intensive green roofs require a minimum slope of 2%; those with slopes less than 2% require additional drainage measures to avoid water logging. Additional requirements include good drainage, lightweight growth media, good waterproofing, additional structural support, rainwater harvesting and the use of drought/heat tolerant plants. While it may be challenging, it is important to engineer for proper drainage, which will avoid root rot on the plants. A thicker substrate needed if drainage is not adequate will also mean higher load bearing, which adds to the cost.

Components of green roofs include: 1.) waterproofing membranes; 2.) insulation (if the building is heated or cooled); 3.) a root barrier to protect the membrane (made of gravel, impervious concrete, pvc, tpo, hdpe, or copper); 4.) a drainage system; 5.) a filter cloth (polyester fiber mats, polypropylene mats or non-biodegradable fabrics); 6.) a growing medium, consisting of inorganic matter (expanded slate, pumice, vermiculite, volcanic rock, etc.), organic material (straw, peat, wood, grass, sawdust, etc.), and air (cavities); 7.) plants.

There are several considerations when choosing the plant material. Overall, plants should be selected for their ability to thrive with minimal to no inputs (water, fertilizers, etc.) after establishment. Appropriate natives are recommended, and all should prefer full-sun and be drought tolerant. Plants should also be cold tolerant and have no severe pest susceptibility or maintenance needs. Root systems should be shallow. Use pollen/nectar producers when possible, which will help not only in pollination but also to attract beneficial insects for biological pest management.

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Operations and Maintenance:

Although plants should be chosen to be maintenance free after establishment, plants will need some maintenance, particularly during establishment, including irrigation system inspections. Annual maintenance walks should be performed until plants fill in.

Credits in Green Building Certification Programs:

- LEED for Homes (SS 4.3 management of runoff from roof)
- LEED for Neighborhood Development Pilot (GCT Credit 9: Stormwater Management)
- NAHB Model Green Home Building Guidelines (1.3.5 Manage storm water using low-impact development when possible)

Relative Costs:

Materials and installation of a typical green roof in the U.S. cost between $15 and $20 per square foot, with the soil substrate, growing medium, and planting materials accounting for the largest portion of these costs. When considering the cost of a green roof, it is important to compare it to the cost of a conventional roof and consider energy cost savings. As a result of the improved insulation properties of a building with a green roof, most applications result in cost savings from improved energy efficiency. A one-story building with a green roof can be expected to save 20%-30% in cooling costs.

References and Resources:

EPA Stormwater BMP Fact Sheet: Green Roof: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=114

Green Roofs for Healthy Cities: www.greenroofs.org.

Green Roofs 101 (The Greenroof Industry Research Portal): http://www.greenroofs.com/Greenroofs101/index.html.

The green roof on the Perry Construction Yard building at the University of Florida is an extensive green roof of 2,600 square feet with a media depth of 5". All plants are less than 30" tall. Two 1,550 gallon cisterns harvest rainwater and serve as the main source of the roof's drip irrigation system, with the campus' reclaimed water system as a backup

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Wanielista, Marty, Mike Hardin, and Matt Kelly. 2007. *The Effectiveness of Green Roof Stormwater Treatment Systems Irrigated With Reclycled Green Roof Filtrate to Achieve Polluant Removal With Peak and Volume Reduction in Florida*. Final Report to FDEP, Project Number WM 864. University of Central Florida, Stormwater Management Academy.

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Credits

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