

Is a **Vegetative Roof** Right for Your Building?

Understand the challenges of installing and maintaining a green roof

BY TED MICHELSEN

Building owners are always looking for new ways to bolster their green credentials, and many have turned to vegetative roofs as a means to improve building performance and display an environmental consciousness. Green roofs will do just that, but they come with a set of distinct challenges for retrofits. Would your building be a good fit for a vegetative roof?



TECH DECK IN MOUNTAIN VIEW, CA, received a 2016 Award of Excellence for its intensive green roof from Green Roofs for Healthy Cities, a non-profit organization that supports the green roof industry in North America.

Components of a Vegetative Roof

Before addressing any of the benefits and challenges of vegetative roofs, it is important to identify their components. Vegetative roofs require adequate structure to support the roof's weight and specific materials to properly maintain the ecosystem and capitalize on the main benefits for a long period. No matter the type of application, you need to consider these components of a vegetative roof.

- Starting at the bottom is the **structural roof deck**. It's most likely metal, but it also could be structural concrete, which might be better because of the weight of the vegetative roof.
- Above the roof deck, you need a **waterproofing membrane** that is covered by other materials and potentially in contact with water a high percentage of the time. This will often be different from a conventional roof membrane, although many of the same products are used for both applications. Use fully adhered or mechanically attached membranes that are reinforced so you won't have ballooning issues that can displace the vegetative materials. You can choose between PVC, TPO, liquid-applied (rubberized asphalt), asphaltic (BUR, modified bitumen and rubberized asphalts) and EPDM.
- The **root barrier** is required in some systems and includes not only the barrier to keep roots from damaging the membrane but also insulation. It is optional depending on membrane type, with asphaltic materials requiring some sort of a root barrier.
- The **retention or drainage sheet** is basically a thin plastic molded sheet that is dimpled and is similar to waterproofing in walls. The retention/drainage sheet can retain rainwater for plant use on drier days, as it will fill up in the low spots and water can later diffuse into the growing media.
- Above the retention/drainage sheet is the **filter layer** or a filter fabric that keeps the growing medium above it from clogging the drainage system.
- The **growing media** is not soil, so you shouldn't dig up top soil from the ground and bring it up to the roof to grow your plants in. This is a manufactured blend of materials to let the plants grow in.
- Of course, the **vegetation** is on top.

Improving Your Building and the Environment

Beyond the clear aesthetic benefits to vegetative roofs, they provide extensive benefits to facilities. The first and perhaps

most important advantage they can provide for facilities is better **stormwater management**. In highly populated urban areas with limited stormwater capacity, stormwater management is a key concern. To address these issues, conventional roofs are designed to let rain water run off of them with slight slopes, and we commonly see specialized roof drain covers that restrict water flow to the drains so that water can be held in a reserve capacity and dribble into a stormwater system to prevent overflow problems. Vegetative roofs instead absorb and hold water from precipitation to naturally delay the flow of water to the drains.

Another environmental concern vegetative roofs address is **reducing the urban heat island effect**. Dark roofs and pavement radiate solar energy back into the environment so that it is several degrees warmer than the surrounding suburban and rural areas. Although they aren't as effective as a highly

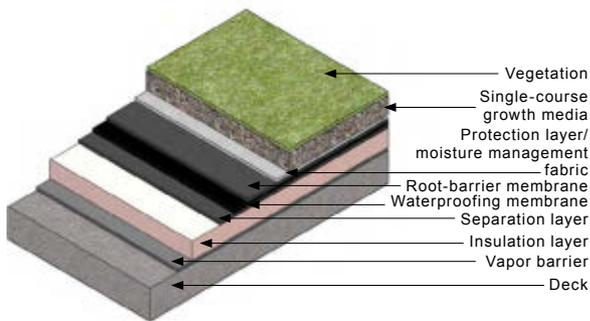
reflective roof, the plants and growing media in a vegetative roof absorb less heat than the dark roof would and therefore radiate less back. Part of the energy that would normally be radiated back from a dark-colored roof is used by the plants, which also evaporate water, thereby cooling the air and helping bring urban heat temperatures down.

In addition to absorbing more sunlight, the plant materials and other components of vegetative roofs **increase overall roof life**. Because the roof membrane is covered and protected from ultraviolet light, it generally has a greater life expectancy. The materials above the roof itself also provide lower temperatures for the membrane, which slows down its aging process.

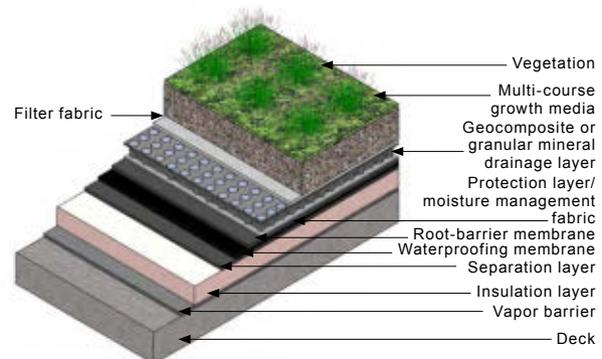
With the extra protection that the plants and materials can provide, vegetative roofs provide **energy savings**. In the summer, the plants can offer shade and lower the temperature of

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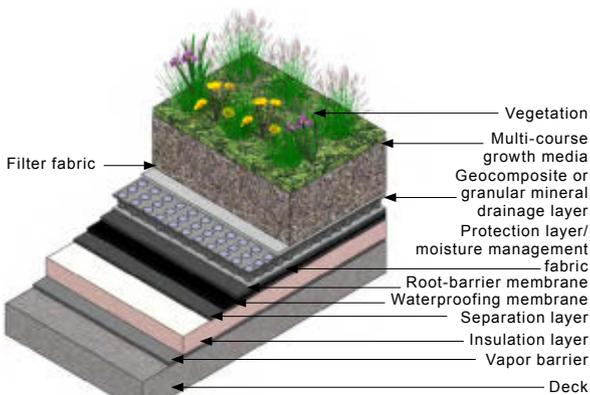
THE STRUCTURE OF VEGETATIVE ROOFS



Single-Course Extensive



Multi-Course Extensive



Semi-Intensive



Intensive

OTHER THAN SOME DIFFERENCES SPECIFIC TO THE TYPE OF ROOF SYSTEM, vegetative roofs employ similar components that allow the roof to function and be sealed properly due to the water needed for plant growth.

GSA

the membrane, which will limit the amount of heat that flows into the building. Moreover, the effect of the evaporative cooling lowers the temperature and amount of heat moving into the building. It is a little more difficult to save energy with them in the winter, but there are some benefits because the added air films prevent heat loss to the environment.

Plants also **improve air quality** by removing carbon dioxide from the air and lowering temperatures. Additionally, the growing media and plants can trap dust

and some types of pollutants, which lowers some of the concerns about the environment.

Other benefits include the restoration of natural habitats for birds (though they also attract insects and other vermin) and the creation of a minor space for recreational activity or to simply go outside, depending on the space. If they can be seen and used, vegetative roofs provide aesthetic and psychological benefits for building occupants.

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SELECTING THE APPROPRIATE WATERPROOF MEMBRANE

Each type of waterproof membrane for vegetative roofs comes with its own pros and cons. Consider these attributes of different membranes for the right fit.

PVC

- Welded seams
- Most common sheet used for green roofs in Europe
- Higher cost
- Uses 60- to 80-mil sheets

TPO

- Welded seams
- Costs less
- Needs thicker sheets
- Confirm whether manufacturer has approved use for green roofs

Rubberized Asphalt

- Good waterproofing
- Designed for waterproof applications
- Monolithic
- Needs root protection
- Higher cost

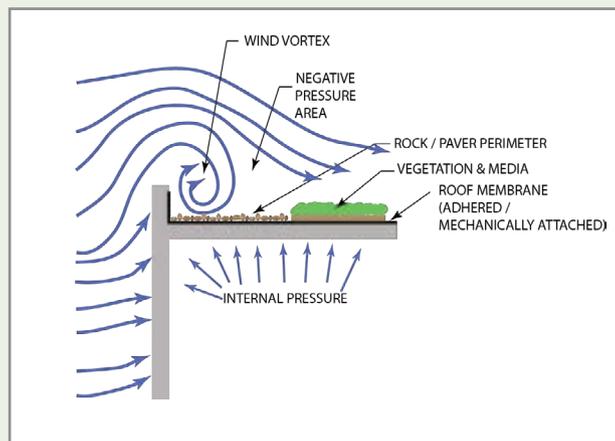
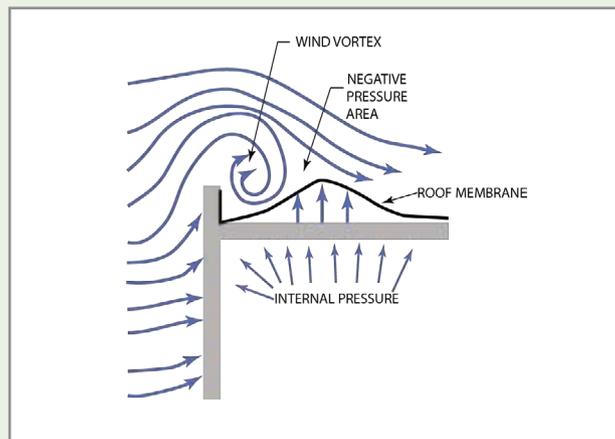
BUR and Modified Bitumen

- Good waterproofing
- Need root protection
- Require more plies

EPDM

- Water-resistant sheet
- Low cost in loose laid systems
- Seam concerns
- Leak finding system does not work with EPDM

REDUCING WIND DAMAGE IN VEGETATIVE ROOFS



WITH A VEGETATIVE ROOF, it is important to be cognizant of wind's effects on vegetation and growing media. Without implementing a paver or ballast area between the roof wall and vegetation, you run the risk of the displacement of plants and growing media.

TYPES OF VEGETATIVE ROOFS

Based on your aspirations, budget and the structural demand for a vegetative roof, you need to consider the different types that range widely in cost and style.

Intensive Vegetative Roof

When you think of green roofs, you are likely picturing an intensive vegetative roof, which is the most attractive and park-like. A lot goes into these roofs. They can have trees put in them, but they need special pits that are pre-designed for trees and large plants. That's a specialty that requires a lot of planning.



INTENSIVE ROOFS can support trees and a wide variety of other plant types, but they are not practical for existing buildings.

Intensive vegetative roofs use a wide variety of plants, shrubs and trees. However, it is important that plants that are selected don't have aggressive root systems, as plants with tap roots or any other invasive root system can damage and penetrate the roof membrane.

Intensive projects require considerable irrigation and maintenance, as trees and shrubs require trimming. They require growth media that is deep (8-24 inches) and heavy (60-200 pcf when saturated).

Because of the structural demands they place on buildings, intensive vegetative roofs are not practical for existing buildings with very few exceptions.

For an intensive roof, you are looking at costs anywhere from \$30-220 per square foot.

Extensive Vegetative Roof

The extensive vegetative roof is still green and has a lot of the same benefits as intensive vegetative roofs, but it is not necessarily park-like in vision. They use simple plants, typically sedum-type varieties. These have some small flowers and color,



AVENTURA OPTIMA PLAZA was recognized by Green Roofs for Healthy Cities for its intensive roof that supports the weight of many trees.

but their main benefit is having non-invasive root systems. Compared to intensive vegetative roofs, they are much more affordable at \$10-25 per square foot depending on elements like railings, irrigation systems and waterlines.

The growing media tends to be 2-4 inches thick weighing 15-30 pcf. While you can get by with 2 inches of growing media, it is much harder to support plant life with thinner media because there is less room for the root systems to grow, less nutrients for the plants and less ability to hold water, meaning you will need to irrigate more often.

Like intensive projects, these typically require irrigation. One problem in the past has been the false belief that you don't need to irrigate outside of



THE EXTENSIVE VEGETATIVE ROOF at the Alberta Ecoroof Initiative includes plant systems and species that can endure Calgary's climate.

the initial stages when the plants are developing. In areas with natural and regular precipitation, you might not need to continue to irrigate except during extended dry periods. In other parts of the country, particularly in drier climates, irrigation is an absolute necessity.

Whether you irrigate or not, you will definitely need to do regular maintenance. If you're on a 50- to 60-story building, you won't have many weed seeds getting up there, but if you are on a 1- or 2-story building, the potential for weeds is high. Weeds by their very nature have aggressive root systems, so you'll need to do something to control them before they can penetrate your roof system.

Weights for extensive vegetative roofs fall in a range that an existing building or roof system can handle, and you have two options for planting vegetation. One is in plastic containers that hold the growing media and plants. With containers, you can pre-start the plants before installation so they get used to the environment and have more developed root systems. They are easier to remove but provide a less flexible layout with their rectilinear shape.

The other option works without containers, as you bring the growing media to the rooftop, level it out and begin planting. Plants can be somewhat mature and grown, but they have to then acclimate to the environment and growing media as they put their roots out. There will be a development time for them to become accustomed to their conditions. If you have to move material to get through the roof system for any reason, you're going to have to move the plants and the growing media and start over again in those areas. It's much more labor intensive and more flexible in design, but not necessarily less expensive.

Semi-Intensive Vegetative Roof

Looking for a happy medium? The semi-intensive vegetative roof is a hybrid system that generally weighs between 25-40 pcf, which typically surpasses the weight capacity for existing roofs. You can include a more diverse mixture of plants.