

It's Raining, It's Pouring, The Green Roof is Storing: Storm Water Mitigation in Green Roofs

Green roofs have long been recognized for their ability to mitigate storm water run-off. Now, as governments in North America are starting to write storm water mitigation and green roof policies into their bylaws, architects and building owners alike are increasingly pressed to prove the performance of the roof system. Even without bylaws in place, it is still critical to understand the inherent differences within green roofs in order to specify the best one based on individual needs.

The U.S. Environmental Protection Agency estimates that a typical city block generates five times as much runoff as a woodlot of the same size. Because urban areas are covered with impervious surfaces that deflect rainwater into storm sewers, these infrastructure systems often become overburdened during heavy rainfall. Studies show that green roofs, dependent upon their substrate depth, can retain 60-100% of incoming rainfall. (Liesecke, 1998; Monterusso et al., 2004; Schade, 2000). Any runoff that does come from a green roof is delayed as a result of the absorption process; green roof storm water runoff is also cleaner due to the natural filtration properties of the vegetation and substrate.

Beyond storm water mitigation, green roofs provide substantial owner benefits. Green roofs slow building heat loss and gain, improving energy performance. Roof vegetation infuses fresh oxygen into the surrounding air through the process of photosynthesis. Green roofs increase the life-span of a typical roof by protecting the roof component from damaging ultraviolet rays, extreme temperatures and rapid temperature fluctuations. These and other benefits of any given green roof are dependent upon the building type and roof system used.

Green roofs fall into two categories – intensive and shallow (or extensive.) Intensive roofs have one foot or more of soil, and typically can support a variety of vegetation and large plantings. These roofs can be accessible and often are an extension of usable building area. By contrast, shallow roofs have nominal soil buildup of as little as one to five inches, and cannot support oversize plants and shrubs. Shallow green roofs are usually only accessed for annual maintenance.

Internationally, builders and architects have long used green roofs on all variety of building types. As these systems gain popularity in North America, facilities with green roofs include manufacturing, single-story office buildings, shopping malls, churches and educational facilities. Involving a green roof expert early in the design process will aid in determining the viability and type of green roof system best suited to a particular installation.

Contrary to common opinion, although excellent for storm water mitigation, flat roofs are not always the ideal for a green roof. A flat roof requires an additional layer to drain excess water away from the root zone. A roof slope between five degrees (1:12) and 20 degrees (4:12) works best because water drains naturally due to gravity. Roofs with up to a 40-degree slope can be greened; slopes greater than 20 degrees require a wooden lath grid to hold soil substrate in place until plants form a thick vegetation mat. (*Green Roofs: Stormwater Management from the Top Down*, Katrin Sholz-Barth, January 2001)

For increased storm water mitigation, the actual engineering of the green roof system is the most important element. The finished roof system is comprised of several layers, commonly known as a build-up. While the build-up composition differs between manufacturers, the essential components are waterproofing, drainage, a growing medium, and vegetation. The performance of the roof is determined in the build-up design. A typical build-up is shown in Figure1.

Figure 1 - Primary Components of a Green Roof Buildup
 Source: National Research Council, Institute for Research in Construction

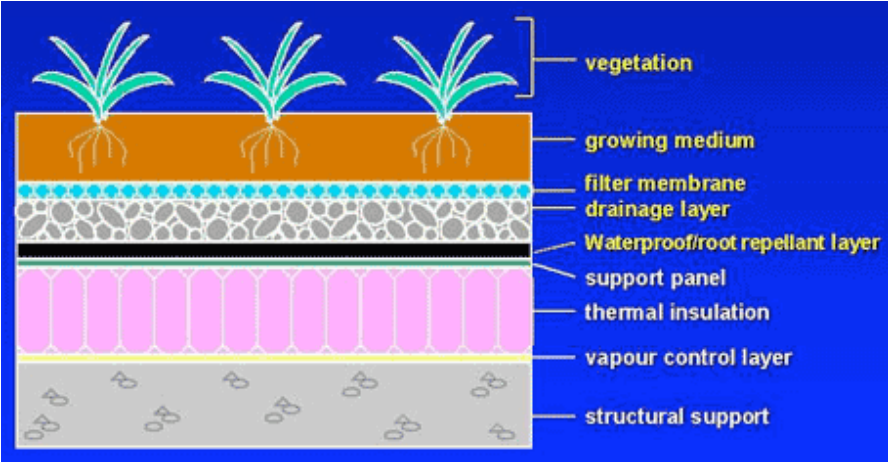
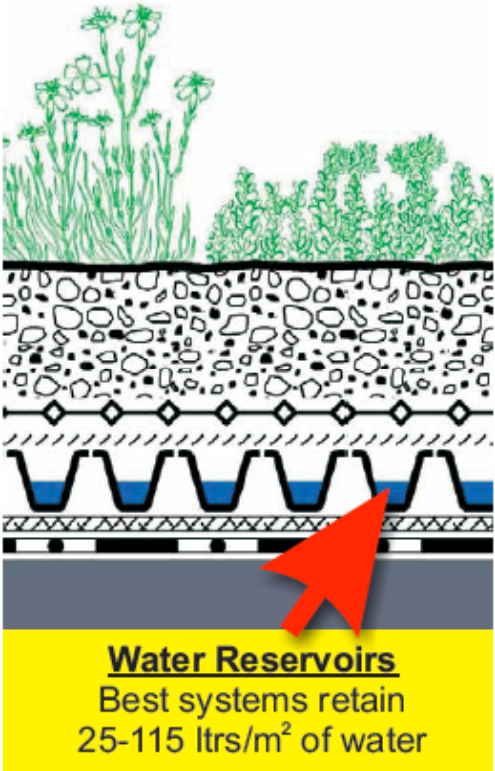


Figure 2 – Water Retention Reservoirs in ZinCo Engineered Build-up
 Source: ZinCo Green Roofs Systems - Germany



Dependent upon climate, usage intent, and the level of owner maintenance desired, many build-ups are available. When it comes to storm water mitigation, the more water a green roof can retain, the better – not just for mitigation but also for plant health and increased roof life. Many green roof systems rely on the growing medium, the plants and moisture mats alone to retain the water, while other engineered systems such as ZinCo™ have water retention reservoirs designed into their drain boards. These reservoirs, designed similar to an egg crate, hold more water, reduce run-off, minimize the need for secondary irrigation, maintenance and cool the roof membrane.

See Figure 2 for details on ZinCo Build-up

Storm water is of concern for two main reasons; the volume and timing of runoff water and the quality of the runoff water. Storm water run-off is already under strict guidelines in many cities. Some are going a step further and introducing language into their by-laws to require green roofs. The City of Richmond in British Columbia recently enacted legislation that requires a minimum of green points earned through green roof applications, in exchange for development incentives.

Green Roofs, Storm Water Management & LEED

Storm water management is clearly dealt with within the US and Canadian Green Building Council LEED reference documentation within the Sustainable Sites section or credit 6.1 and 6.2.

Section 6.1 deals with rate and quantity of run-off stating that any site where the imperviousness is greater than 50%, a storm water mitigation plan should decrease the run-off by 25%.

Section 6.2 deals with the treatment of storm water by limiting the disruption of natural water flows, eliminating storm water run-off, increasing on-site filtration and eliminating contaminants.

Green roofs can account for up to 15 points under the LEED rating system, depending on the design and integration with other building systems. (*Green Roofs and Maximizing Credits under the LEED™ Green Building System, Richard Kula, Spring 2005*)

Development incentives for green roofs include:

- Potential for faster approval process for new projects
- Potential for reduced storm water/wastewater charges from local municipality or utility.
- Potential to reduce the size of storm water management ponds or cisterns, resulting in cost savings.
- Potential for grants related to energy efficiency and/or green roofs.
- Potential for density bonuses / larger floor area ratio.
- Potential to satisfy regulatory requirements for green roofs.
- Potential to score more than 7 credits under the US and Canadian Green Building Council LEED certification system.
- Potential for satisfying minimum parkland / green space set aside, requirements.
- Potential for greenhouse gas emissions trading credits, stemming from energy savings.

HELPFUL LINKS

<http://www.greenroofs.org/>

<http://www.igra-world.com/>

<http://commons.bcit.ca/greenroof/>

<http://www.zinco-usa.com/>

<http://www.architek.ca/products/greenroofs.asp>

<http://www.cagbc.org/>

<http://www.usgbc.org/>

ABOUT THE AUTHOR

Ron P. Schwenger is the founder and president of Architek.ca. Mr. Schwenger has a background in architecture, sustainable building envelope design as well as marketing and communications. He has worked with the world leader and green roof manufacturer for five years, giving him technical expertise on green roof applications and installation. Ron is pleased to have assembled a best-of-class group of green building product partners including: ZinCo Green Roof Systems, Sanyo Photo-Voltaic Solar Energy, Rehau High-Performance Window, Door & Curtain-wall Systems and DayLite Natural Lighting Solutions.