Green Roofs

Our traditional view of urbanization usually means buildings separated by paved areas with some attempt at creating small, strategically placed green spaces that require irrigation, mowing, pruning, pesticide inputs, and fertilization. Pavement prevents precipitation from entering the soil and requires engineered drainage structures to carry the water away. Runoff from paved surfaces picks up and carries chemical and biological pollutants as it flows downstream. Pavement and buildings also absorb heat which artificially raises ambient temperatures and increases energy consumption.

Architects and urban planners are trying to soften the impacts of urbanization by creating/maintaining open space, using pervious paving materials, and incorporating new building technologies. Green roofs are one such technological tool that can improve the environment. Green roofs are specially engineered systems that replace conventional roofing materials with living plant communities. The concept has been used by many cultures from the Hanging Gardens of Babylon to traditional Navajo hogans. Modern green roof technology began in Germany about 30 years ago and has taken root around the world.

Green roofs combine plant biology, hydraulic engineering, and architecture to create living ecosystems that insulate the structure, filter environmental pollutants, and enhance the environment while providing a waterproof roof. Green roofs are categorized as either intensive or extensive. Intensive green roofs are high profile roof gardens that include trees and shrubs and may be accessible to the public with paths and benches. Intensive systems are often on flat, concrete roofs that require deep soil media and a strong supporting structure.

Extensive green roof systems, also called eco-roofs, are designed primarily for environmental benefits and are very suitable for use on residential and small commercial buildings. They utilize a lightweight soil medium between 1 and 7 inches deep. Plant species are often alpine-type perennial grasses and forbs adapted to the local climate. The pitch of the extensive green roof is ideally 5 to 20 degrees, but can be as steep as 40 degrees if an additional grid structure is used. Irrigation systems can be installed for establishment and watering during periods of extended drought.

Both intensive and extensive green roofs have similar designs. The foundation of a green roof is a waterproof membrane followed by a root barrier. Above this are a drainage layer (perlite), a filter fabric for fine soils, the engineered growing medium or soil substrate, and the plant material. Usually some form of a biodegradable erosion or "wind blanket," such as a jute or coco liner-type mesh, is placed over the new plants to stabilize establishing roots.

Structures must be engineered to support the weight of the green roof materials or analyzed by qualified experts when retrofitting. Intensive systems can weigh up to 50 lbs per sq. ft. while extensive systems weigh in at 15 lbs per sq. ft. Green roofs can cost 30 to 60% more than conventional roofing materials. However, in some states, there are financial incentives and/or grants available to subsidize the cost of green roofs. Some green roof systems are reported to last from 40 to 75 years. This is considerably longer than many conventional roofing materials.

There are several environmental benefits realized with green roofs. Stormwater volume is reduced decreasing the strain on infrastructure. Water quality is improved through absorption of nitrogen, phosphorus, and other compounds by the plants and soil organisms. Energy consumption is reduced because the building has greater insulation and the plant canopy cools the roof surface. Air quality is improved because the plants and soil organisms absorb smog, sulfur dioxide, carbon dioxide, and other pollutants. Green roofs also create outdoor spaces for humans and habitat for birds, butterflies, and other beneficial insects.

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