ECO OR GREEN ROOFING

Introduction

A green roof system is an extension of an existing roof that contains water proofing and root repellent systems, a drainage system, filter cloth, lightweight growing medium, and plants. The green roofs can be extensive with small plants and grasses, semi intensive with herbs and small shrubs, or intensive with parks, side walks, trees, and even pools of water. Green roofs have numerous benefits to both the building on which they are built and, on a larger scale, the city in which they exist. By building a green roof, users can increase the energy efficiency of their buildings, lower the level of air pollutants in the area, moderate the overall heat of the city, reduce the effects of rain water run off, add biodiversity to otherwise barren areas, and provide an outlet for urban agriculture. The only major downsides to green roofs are the cost of installation, the maintenance required, the risk of water leaking through the water resistant layer, and the added structural weight of the green roof on the building.

History

Green roofs have been in existence since the Hanging Gardens of Babylon in 500 BC. These gardens were constructed over beams and coated with tar and reeds to waterproof. During the Viking times and the Middle Ages, people covered their roofs in sod to provide insulation during the winter and cooling during the summer. These first examples of green roofs were not water proof or free from animal infestation making them some what uncomfortable on occasion.

In the 1960's the modern green roof came into existence in Germany. Reinhard Bornkamm, a researcher from Berlin's Free University, published a work on green roofs in Germany that caused more research into the area. After this increase in research, green roofs became more widely used in Europe during the 1970's. These green roofs had similar characteristics to the sod roofs, but featured water proofing, irrigation, and protection from roots growing into the buildings. In the late 1980's, extensive (see extensive roofs) green roofs were developed to provide a cheaper, lighter version of the previous green roofs that could be built on top of large flat buildings. The main benefits from these new roofs were protection of the roof from environmental impacts and reduction of temperature fluctuations throughout the building.
Researchers then began to find many more benefits to the these green roofs including increased energy efficiency, moderation of the Urban Heat Island Effect, improved air quality, storm water management, biodiversity, and urban agriculture. Today, green roofs can be found in most developed countries around the world, the majority of them being in European countries. Chicago, New York City, Portland, and Washington D.C. have all created city wide programs to promote the use of green roofs in their cites.

Types of Green Roofs

**Extensive**

Extensive green roofs are best suited for roofs with low load bearing capacity. They are mainly used in areas that have The mineral substrate layer is about 6 inches deep, and the plants in it are drought tolerant plants because of the exposure of the roof to sun, wind, and drought. In addition to these, many other small plants such as mosses, herbs, and grasses are mixed in to add variety to the plants.

In general, the extensive roofs are less expensive than the other two types of green roofs, but they provide less variations in design of the roofs and the types of plants used. No shrubs, bushes, or trees can grow in these types of roofs.

**Semi Intensive**

Semi intensive green roofs fall in between the other two categories. A deeper layer of substrate allows for more variety in plant life, design of the roofs, and larger plants. Herbs, grasses, and shrubs can all easily grow in this type of green roof.

The semi intensive green roofs weigh more, are more expensive, and require more maintenance than the
Intensive green roofs are by far the most versatile and diverse of the three types of green roofs. Lawns, bushes, and trees can be planted on these types of roofs. Walkways, bridges, benches, and even ponds can built on these as well. Additionally, small plot farms can be planted to provide a local produce and reduce dependency on shipped in produced.

More planning is required to make these roofs because of their weight, diversity of plant types, and intensive maintenance. Irrigation systems and frequent fertilization are often required. Because of these factors, intensive is the most expensive to build, plant, and upkeep.

**Benefits of Green Roofs**

**Increased Energy Efficiency**
One of the down sides of building large structures in cities is that they are often hard to make very energy efficient. By placing plants and substrate on top of the roofs, the buildings are more insulated during the winter and cooler during the summer, reducing the amount of energy required to heat and cool the buildings and thereby improving sustainability.

**Moderation of the Urban Heat Island Effect**
Urban Heat Island (UHI) is a phenomena that occurs because of urban development. Surfaces that were once moist and permeable such as trees and grass are replaced with hard, dry surfaces such as concrete and asphalt. UHI causes urban areas to have higher temperatures than the rural areas that surround them. By covering the roofs which are often the hottest surfaces in a city with vegetation, green roofs can absorb the heat from the sunlight effectively reducing the overall effect of the UHI.

**Improved Air Quality**
In urban areas, the air is often polluted with fumes and other various chemicals. Although there are programs set in place to filter out these pollutants from factories, cars, and buildings before they reach the atmosphere, not many cost effective solutions exist to treat the pollutants that are already in the air. Green roofs are an excellent options for this process. The various parts of the vegetation provide a large surface area and roughness to act as sinks for the pollutants. Although larger trees are preferable to perform this function, sufficient space and surfaces for planting trees are limited in cities so green roofs are an excellent alternative because they can grow vegetation on surfaces that would other wise be impervious to trees. Improving air quality in a city will allow the city to be a safe, healthy place to live for generations to come.

**Storm Water Management**
The green roofs collect and retain rainwater then slowly release the water into the environment through the transpiration of the plants and through evaporation. Because they retain and slow the diffusion of roof water runoff, green roofs lessens the impact that rain runoff has on city sewer systems during peak drainage. Additionally, the water that runs off is cleaner because it is filtered by the layers of substrate.

**Disadvantages of Green Roofs**

**Installation Costs**
The estimated cost for installing a green roof is $10 for an extensive roof and $25 for an intensive roof. Compared to the normal cost for a roof, green roof installation can be pricey.

**Maintenance**
Green roofs need to be maintained at all times. Extensive roofs need to be checked for weeds and seedlings on a regular basis, and Intensive and Semi Intensive roofs both require a large amounts of irrigation and grooming. A green roof takes longer to maintain then if it was just a flat piece of concrete.

**Leaking**
If the water sealant were to break, massive damage could be done to the unprotected roof because the water would simply stay on the roof and slowly rot away the roof. If leaks occur, it can be difficult to find the leak and repair it.

**Added Structural Weight**
Because of all the material that goes into making a green roof, the roof is far heavier than a regular roof. Because of this, green roofs have to be designed on a case by case basis to avoid overloading the supports under neath.

**Applications of Green Roofs**

**New Buildings**
When constructing a new office building, green roofs can be designed for and built into the construction of the overall structure. This allows for more supports to be built in for the green roof and more freedom in the overall design of the roof. By building green roofs into new buildings, the buildings can have more elaborate green roofs as well as better layouts of the roofs.

**Retrofiting**
In older buildings, green roofs are sometimes added later to for the reasons given before. Careful calculations are required to be sure that the loads applied do not exceed the structures limit. These roofs
are commonly extensive because of the necessity for lighter loads in some cases.

**Successful Projects**

**Chicago City Hall, United States**
One of the first green roofs built in the United States, Chicago City Hall's roof is designed in a sunburst pattern that is in line with the building's design. The green roof effectively increased the efficiency of the building.

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