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GREEN ROOF BENEFITS

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Green roofs have many benefits, all of which can be assigned a monetary value.
In North America, rarely does any single benefit justify the decision to install a green roof. However, taken together, the combined benefits provided by a green roof can make them attractive alternatives to conventional roofs.

The benefits of green roofs include their capacity to:

1. Extend the **service life** of the underlying waterproofing system
2. Increase **thermal efficiency**
3. Reduce **rainfall runoff** impacts
4. Reduce **sound** reflection and transmission
5. Enhance **property values**.

All of these translate into a financial benefit for the owner or developer. Depending upon the local circumstances some benefits may be more important than others.

Extending Service Life

Thirty-five years of experience with green roofs in Germany has demonstrated their value in protecting waterproofing materials. **A roof assembly that is covered with a green roof can be expected to outlast a comparable roof without a green roof by a factor of at least two, and often three.** Although modern green roof systems have not yet been in place longer than 35 years, many researchers expect that these installations will last 50 years and longer before they require significant repair or replacement.

For a building owner with a long-term investment in the roofing system, this benefit factor goes a long-way toward paying back the initial investment in a green roof. Taken by itself,
this factor may not be sufficient to fully compensate the owner for the higher installation cost of a green roof; however, other benefits to close the gap.

Adding Thermal Efficiency

The addition of a green roof will reduce heating and cooling costs. The magnitude of this benefit can vary widely depending upon project specifics. The benefits will be greatest for large single-story structures where the roof area is a large percentage of the total 'skin' of the building. Site-specific energy savings can be computed for projects incorporating green roofs.

From a heat flow perspective, the performance of green roofs as 'insulators' depends greatly on a number of variables, including the moisture content and temperature regime. In fact, the physical processes producing the benefit are many and varied. The benefits associated with **shading, reduction in advective (wind) losses** and **heat absorption (thermal mass)** are as important as **insulation.** For this reason, it is impossible to regard green roofs as equivalent to conventional insulation materials. It is much more useful to think of green roofs as **systems that greatly improve the function of conventional insulation materials.**

Generally, green roofs provide a greater benefit in the summer than in the winter. However, their capacity to virtually **eliminate the daily variation in temperature** is a year-round phenomenon. Furthermore, green roofs are up to twice as efficient as white or reflective roof surfaces in reducing thermal gain. Quantitative analysis of energy benefits can be conducted on a project-specific basis.

Reducing Rainfall Runoff Impacts

Green roofs create a dramatic reduction in both the quantity of rainfall runoff and the rate of runoff.[1] This benefit has spurred in the widespread implementation of green roofs in Germany. For a typical 3-inch green roof, rain water is retained until rainfall volume exceeds .6 inch. On an annual basis, total rainfall runoff quantity will be reduced by 50 percent, or more. The effect on runoff rate is similarly large.

The direct benefit to the owner depends on how rainfall runoff is regulated by the local municipal authority. For communities where runoff controls are evaluated on the basis of the *rational method* (which emphasizes the impact of intense short-duration storm events), green roofs can typically satisfy runoff management for 10-, 25-, in some cases even 100-year return design storms. Where design storms are based on 24-hour events, it generally possible to demonstrate control of runoff for storms up to several inches in magnitude.

To the extent that green roofs meet requirements to reduce runoff rate, other retention devices like stormwater basins, below grade detention storage, etc., can be reduced in size, or eliminated. In urbanized areas the savings is two-fold:

- **Reduced site development costs**
- **Increased commercial space** (otherwise consumed by stormwater detention basins)

[1] Miller, C, and Pyke, G., *Methodology for the Design of Vegetated Roof Covers*, 1999, Proceedings of the1999 International Water Resource Engineering Conference, ASCE, Seattle, WA.

The savings in site development costs alone might typically provide a value of $2 per square foot of roof area, or more.[2]

Green roofs are also bio-filtration devices that improve the *quality* of rainfall runoff. The effectiveness of green roofs in improving water quality has been proven in large-scale demonstrations in Germany.[3] New Federal regulation under Phase II of the NPDES program will mandate management of runoff water quality. Depending upon on local conditions, green roofs can become an important method of complying with these requirements. Therefore, green roof might also help defray site development costs associated with runoff water treatment.

Reducing Sound

Green roofs can be used as effective sound attenuation systems. In one dramatic application, they have been used to address sound impacts from air traffic at the Frankfurt airport. In this case, green roofs were installed on buildings that lie below the approach flight path to mitigate impacts associated with expansion of the airport.

A German article referring to this project asserts that the plants alone reduce reflected noise by 2 to 3 decibels and that the media (soil layer) further reduces sound reflection and transmission. **A simple 3-inch thick green roof can be expected to reduce sound transmission by a minimum of 5 decibels.**

For projects where abatement of ambient noise is important, green roofs may be better a solution than other alternatives, such as baffles and textured surfaces. The savings afforded by eliminating these ancillary features is properly an added value of the green roof.

Adding Property Value

In addition to all other benefits, green roofs are an attractive and dramatic architectural amenity. In new projects, they can be incorporated as essential elements of the overall landscape. More importantly, they can transform existing structures by **converting rooftop eyesores into assets.** In many cases they may also be used to provide passive recreational space for employees and clients. **This translates into dollars and cents in the form of higher rents and increase resale value.** In many instances, this value alone can justify the installation of a green roof.

[2] Compare savings to that associated with projects in Germany. In Germany, property owners are assessed an annual fee for runoff management. This pays for maintenance and upgrades to storm sewers and related utilities. This annual fee is commonly about $.20 per square foot of impervious surface. To the extent that runoff is managed onsite, this fee can be avoided. Green roofs are a common method of eliminating this annual expense. The **present value** of this savings to owners would be about $3 per square foot of roof area.

[3] Köhler, M. & Schmidt, M., *Untersuchungen an extensiven Dachbegrünungen in Berlin: Teil III: Stoffruckhalt, (***Investigations of Extensive Roof Greening in Berlin***),* 2003.

Conclusion

The value of a green roof will depend upon many factors that are specific to a particular application. In many instances a $7 per square foot investment in a green roof will easily be justified.

European experience demonstrates that a uniformly vegetated 'extensive' green roof with 3 inches of media will provide the highest benefit-to-cost ratio. Improvements associated with thicker and more intensively landscaped systems are marginal.

Over the next couple of years, we expect the overall cost of green roof systems to decline by about 25 percent, making them even more cost-effective.