Hybrid Vegetated / Ballasted Roofs: A "Cool" Way to Accelerate Green Roofing Demand?

New Ballasted Roofing Research Offers Intriguing Possibilities

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BALLASTED AND GREEN ROOFS: COMMON FEATURES

Ultraviolet Protection

Although the inclusion of live vegetation makes the green roof unique among modern roofing systems, green roofs share a distinctive feature with another popular roofing system, the *ballasted* roof. Both green roofs and ballasted roofs are designed to protect the underlying roof membrane from direct ultraviolet attack. Green roofs provide this protection by the plant media and vegetation covering the roof membrane; while ballasted roofs achieve the same effect by covering the roofing membrane with a layer of stone aggregate or concrete pavers:

Green (Vegetated) Roof: **Ballasted Roof:**

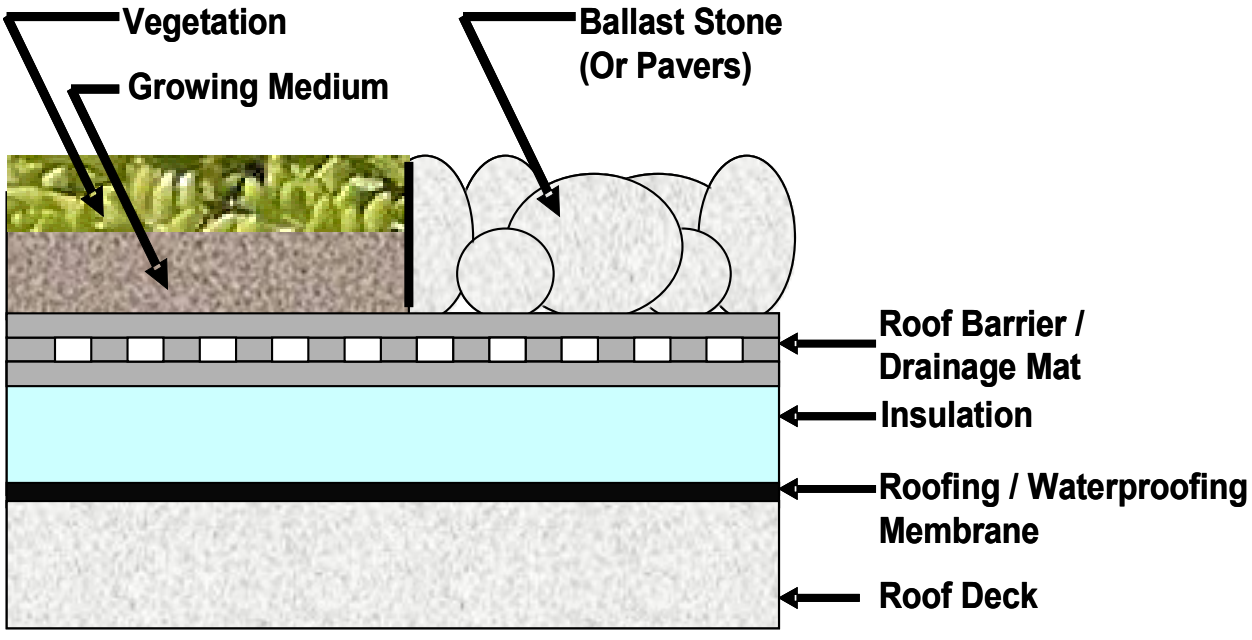


Figure 1:
Green Roof / Ballasted Roof Comparison

Heat Island Mitigation / Energy Savings

Recent research suggests that green roofs and ballasted roofs may also share another important feature. Just as it has been previously demonstrated that green roofs may mitigate urban heat island and ozone problems[1]; new research suggests that ballasted roofs provide a similar benefit. In a two-year project comparing ballasted roofing systems to highly-reflective "cool" roofs[2], researchers at Oak Ridge National Laboratories demonstrated that ballasted systems may offer the same positive impact as roofing membranes currently endorsed by the Federal ENERGY STAR and California Title 24 programs as cool roofing products. The study also suggested that ballasted systems tend to delay the release of heat during the day, potentially reducing peak cooling demand in urban areas in a manner similar to green roofs:

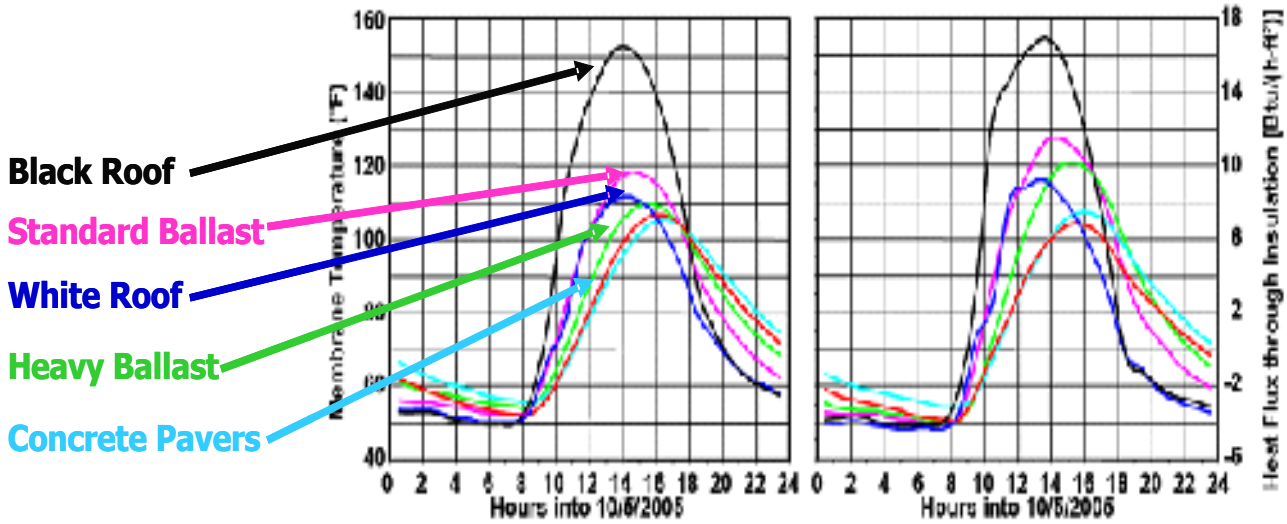


Figure 2:
Comparative Roof Surface Temperature and Heat Transfer
(Source: *Evaluating the Energy Performance of Ballasted Roof Systems*. Oak Ridge National Laboratories, ORNL Report Number UF-04-396, September, 2006.)

GREEN / BALLASTED ROOFING HYBRIDS: THE MARKET OPPORTUNITY

Because ballasted roofs may provide heat reduction benefits like vegetated roofs, the use of "hybrid" green roofing systems consisting of well-designed combinations of ballast and vegetation may be helpful in stimulating increased demand for green roofs. This may be especially important in regions where urban heat mitigation may be a critical design factor, including the "sun belt" of the United States as well as large urban areas subject to high summer cooling demands and ozone levels.

Economic Factors

The drivers for increasing overall demand for green roofing through the use of combined vegetated / ballasted roofs are both economic and environmental. In terms of economics, ballasted roofs offer one of the lowest initial costs of current low-slope roofing technologies. Compared to the complex materials required for a well-designed vegetated roof (including waterproofing membrane, root barrier, planting medium and vegetation) a simple ballasted roof requires only a waterproofing membrane and a layer of relatively inexpensive river-washed stone. The material economies of a ballasted roof in turn translate into reduced installation labor costs. And recent life-cycle cost studies of roofing systems suggest that the overall life cycle cost of ballasted roofs may be lower than other low-slope roofing alternatives[3]:

Ballasted Roofs Offer Low Life-Cycle Cost

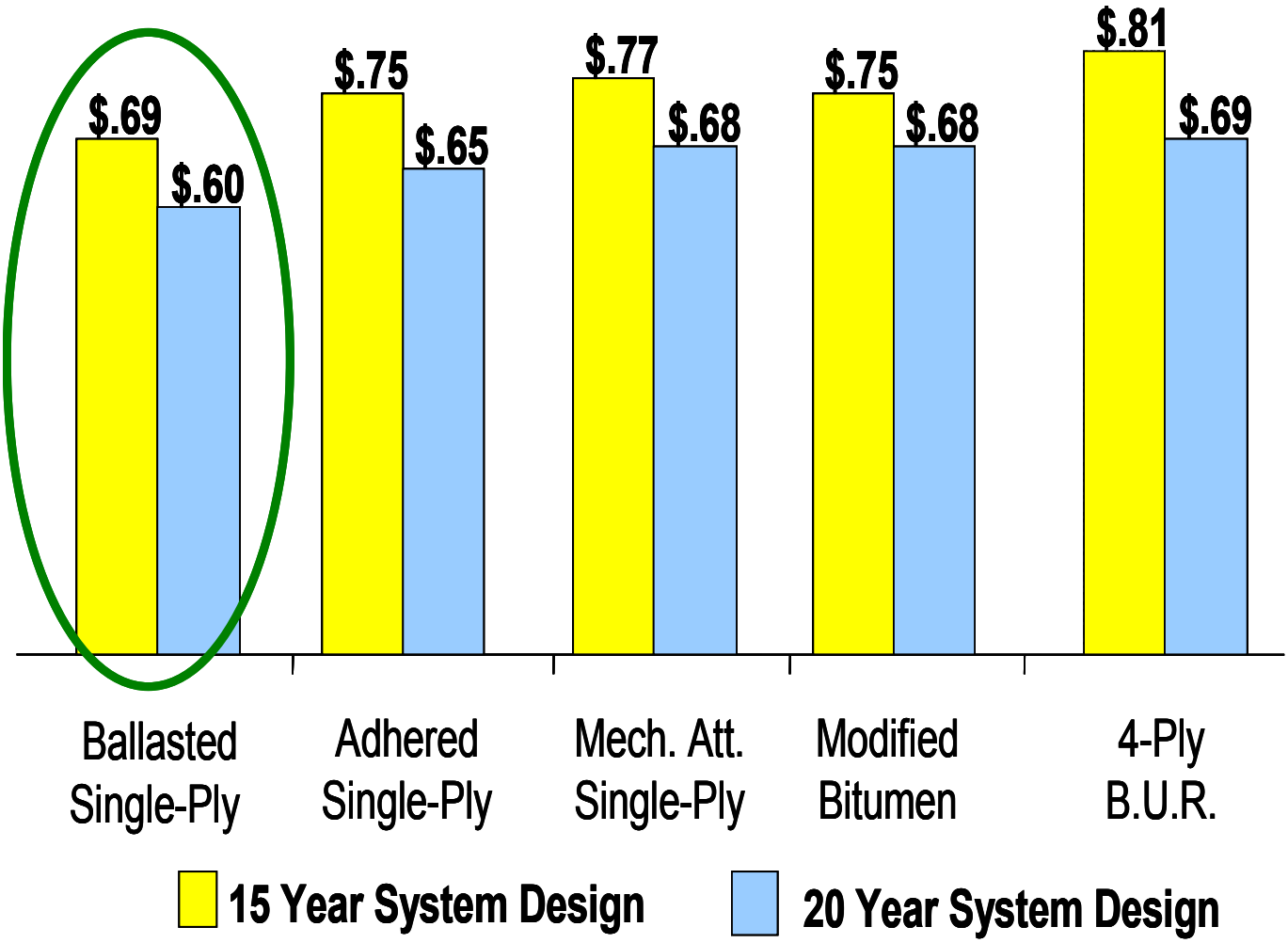


Figure 3:
Comparative Roof System Life Cycle Cost

Equivalent Uniform Annual Cost: Dollars / Square Foot / Service Year

(Source: "Equivalent Uniform Annual Cost: A New Approach to Life Cycle Analysis." *RCI Interface*, January, 2007)

Environmental Factors

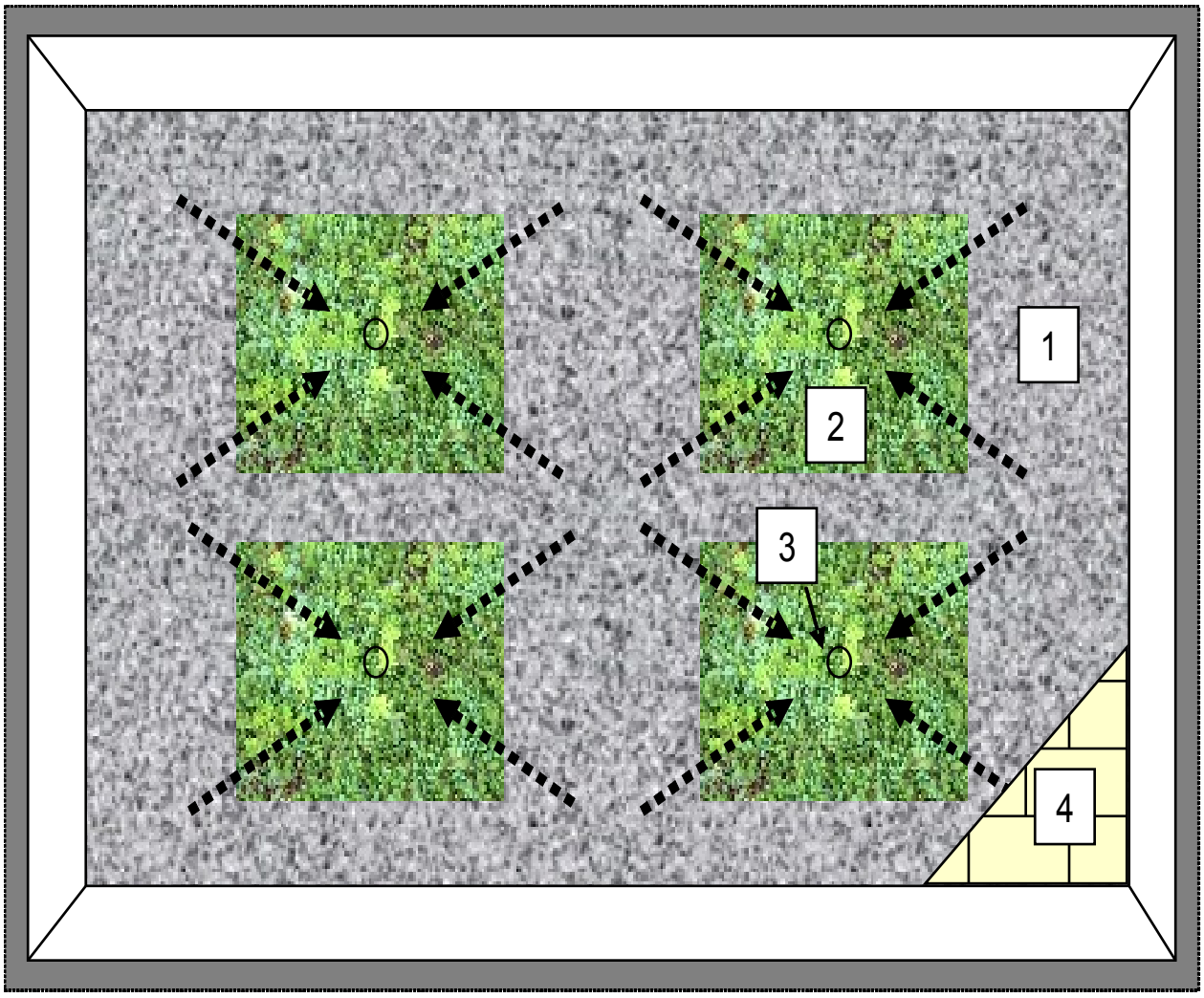
The potential environmental drivers for ballasted roofs may be viewed as synergistic benefits of their design simplicity and low life-cycle cost. Because a ballasted roof membrane requires a minimal amount of adhesives, it emits few VOCs or potentially toxic chemicals during installation and over its service life. Because a ballasted roof requires few mechanical fasteners to restrain it against the wind, the roofing membrane can be easily removed at the end of the service life for recycling. In fact, over one million square feet of ballasted roofs in North America have been recycled during a 2007 trial program sponsored by a roofing trade association[4]. And because the useful service life of a well-designed and maintained ballasted roof may be as long as many other roofing systems, the low initial cost and the ease of removal/ recycling combine to minimize long-term environmental impacts. Figure 4 illustrates the removal and recycling of a typical ballasted roof:

Figure 4:
Ballasted Roof Recycling Steps
(Source: EPDM Roofing Association)

THE CASE FOR GREEN / BALLASTED HYBRIDS

Although ballasted roofs may provide heat reduction benefits like vegetated roofs, they should not be considered a direct alternative. In addition to heat reduction, vegetated roofs provide many other important benefits, including storm water retention, water filtration, and increased thermal insulation. However, if the use of judiciously-designed combinations of ballast and vegetation is helpful in stimulating increased demand for green roofs, the overall environmental benefit may be considerable. If the ballasted areas were located around the perimeter of the roof, the ballasted portions could be designed to accommodate high winds, which may be very important in meeting building code requirements on tall urban buildings. Finally, if the ballasted areas were designed to accommodate and direct traffic on the roof, maintenance could be simplified and human use of the green space could be maximized.

Figure 5 shows a hypothetical example of a ballasted/vegetated roof. If roof drains were located directly beneath the vegetated portions of the roof and the roof designed to slope toward these drains, it is likely that storm water would be retained within the ballasted portions of the roof until the water could be utilized within the vegetated areas.



1	Ballasted Areas
2	Vegetated Areas
3	Roof Drains
4	Tapered Insulation System Sloping to Drains

Figure 5: Hybrid Vegetated / Ballasted Roofing System

CONCLUSIONS

In reality, the hypothetical roof shown in Figure 5 may be a relatively common example of how many green roofs are designed and installed today. But because there has been little discussion of the potential benefits of this hybrid approach, it is likely that the real benefits of such an approach are not commonly understood and accepted by the public. The potential benefit of such a synergy may only be increased with additional research into ballasted roofing systems. For example, research to measure the impact of ballast on storm water retention would be very useful to architects attempting to minimize or eliminate storm water runoff from a building site. In a similar manner, studies of actual public usage of green roofs with extensive ballasted walking areas would be useful in documenting the overall social benefits of green roofs.

Given the opportunity to stimulate demand for green roofs, several organizations within the roofing industry, including the EPDM Roofing Association and the Center for Environmental Innovation in Roofing, are actively involved in ongoing research efforts. Part of these efforts include advocacy for formal acceptance of ballasted systems as a recognized “cool” roof within the ENERGY STAR and California Title 24 programs. In addition, research on how water retention and filtering may be optimized in hybrid green/ballasted roofs will be an important factor in increasing demand for green/ballasted systems. Hopefully, new research will be available in the near future to further support the viability of the green/ballasted concept and increasing opportunity for green roofing installations.

FOR MORE INFORMATION…

Research organizations and industry associations interested in advancing research for hybrid / ballasted hybrid roof systems should contact:

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[1] "Plant-Covered Roofs Ease Urban Heat." *National Geographic News*, November 15, 2002.
[2] *Evaluating the Energy Performance of Ballasted Roof Systems*. Oak Ridge National Laboratories, ORNL Report Number UF-04-396, September, 2006.
[3]"Equivalent Uniform Annual Cost: A New Approach to Life Cycle Analysis." *RCI Interface*, January, 2007.
[4]"An EPDM Recycling Initiative Explores the Environmental Potential of EPDM." *Professional Roofing*, April, 2007.

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