BEST PRACTICES IN ROOFING
» CHOOSING LONG-TERM SUSTAINABILITY

Annie McCarren, Construction Writer,
Carlisle Construction Materials

Roofing Materials: Assessing Environmental Impact

BLACK TOP
Left: Dark-colored EPDM roofs—as at North Collins Elementary in North Collins, N.J.—can reduce heating costs in cool climates. **Above:** Melting snow indicates thermal bridging.

When selecting a sustainable roof system, it is important to examine the environmental impact of the roofing materials themselves. One way to accomplish this is through a Life Cycle Assessment (LCA), which is a cradle-to-grave scientific evaluation of the ecological aspects and potential effects of a product, process or service.

A study entitled "Life Cycle Inventory and Assessment of Low-Slope Roofing Systems in North America" examined EPDM, TPO, PVC and SBS modified bitumen roofing systems. The study held the service life constant at 15 years for all system types and used the U.S. Environmental Protection Agency's (EPA) Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) model to account for all inputs associated with the manufacture and installation of the different roofing systems. The study concluded that EPDM roof systems have the lowest global warming potential, smog impact and acid rain impact.

Colleges and universities have a long history of leading by example with environmentally friendly building design. A wide variety of sustainable single-ply roof systems are marketed to school and university buildings, each with their own specialized benefits. Reflective EPDM, TPO and PVC roofs can keep buildings cool and reduce air conditioning use in hot climates; roof gardens can mitigate stormwater issues; and dark-colored EPDM roofs are durable and can reduce heating costs in cool climates.

However, ensuring the sustainability of an entire roof system is more complicated than simply selecting environmentally friendly roofing materials. The long-term performance of a roof is perhaps the most important aspect of its sustainability.

The most sustainable roof for any building is always one that is geographically appropriate, durable, and well-installed. Yet with so many roof systems and materials available, it can be difficult to know which to choose. Unfortunately, there is no simple answer. When selecting a sustainable roofing system, there are many factors to consider.

Geography and Climate

Geography and climate both play big roles in determining which roof will work best for a specific building. There is no "one-size-fits-all" roofing system that provides equal energy-efficiency benefits in all climates; the perfect roof for a warehouse in Florida isn't necessarily ideal for a university building in Boston.

In cities with long cooling seasons and short heating seasons, like Miami, reflective "cool" roofs can provide a net annual energy savings by reducing a building's air conditioning use. But in cooler, northern, heating-dominated climates, the use of reflective roofs will likely incur a significant "heating penalty." This can be very costly, as buildings' heating costs in cool climates can be up to five times greater than their cooling costs. Tools like the U.S. Dept. of Energy's DOE Roof Savings Calculator can help builders determine the most energy-efficient roof color for their building.

Energy-Efficient Design Principles

To achieve long-term sustainability, it is important to follow sound design principles. Certain design and installation techniques can significantly increase the long-term service life and energy-efficiency of a roofing system:

Eliminate Thermal Bridging of Fasteners

Thermal bridges occur when a conductive element, such as a fastener, passes through or bypasses a roof's thermal barrier. Thermal bridges provide heat with a path of lesser resistance through the insulation, and can reduce the roofing system's R-value by 3%-8%. You can typically observe snow melting above fasteners and plates indicating where the building is "leaking" energy. Selecting a fully adhered roofing system, in which the insulation layers and membrane are set in adhesive, eliminates the thermal bridging of fasteners. Ballasted systems are also an excellent choice, since they use very few fasteners.

Incorporate Air/Vapor Barriers

Air and vapor barriers (AVBs)—along with the appropriate detailing—dramatically reduce air leakage into and out of the building envelope, which is one of the leading causes of energy waste in mechanically attached roofing systems. A study conducted by the National Institute of Standards and Technology concluded that minimizing air leakage can result in energy savings as high as 37%. In both warm and cool climates, the use of AVBs can enhance the performance of the building envelope, significantly reduce a building's energy usage, and help guard against potential condensation issues.

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Minimize Thermal Bridging of Insulation Joints

Continuous vertical joints through the full insulation thickness reduce thermal efficiency by up to 10% and provide a pathway for air to gain access to the cold underside surface of roofing membrane. Using multiple layers of insulation and staggering the joints reduces thermal loss. By determining the geographically appropriate roof color, selecting materials with low environmental impact, and eliminating thermal bridging losses, universities are teaching sustainability through example as well as instruction.