Cool Roofs are Green Roofs: Five Things to Remember when Considering a Cool Roof

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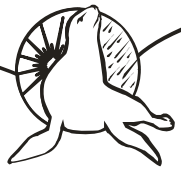
Traditional asphalt shingle roofs absorb a large amount of radiant energy from the sun often creating what are called "heat islands". The heat island caused by the roof causes the temperature of the surrounding air to rise as well. Indeed, according to a 2000 study by the Lawrence Berkeley National Laboratory, the surface temperature of a typical black asphalt roof can be as high as 170 °F in the summer in a warm sunny climate, even if the outdoor air temperature is only around 90 °F. This heat island effect causes the building's HVAC system to have to work harder to maintain a comfortable interior temperature of 70 °F, because the temperature difference between the roof and the inside thermostat is 100 °F.

Some of the incremental strain on HVAC systems can be alleviated through the use of a "cool roof", which as it reads, works to reduce the temperature of a building's roof. The Lawrence Berkley National Laboratory Heat Island Group has monitored buildings in Sacramento with lightly colored, more reflective roofs. They found that these buildings used up to 40% less energy for cooling than buildings with darker roofs1. The Florida Solar Energy Center performed a similar study, also showing up to 40% cooling energy savings2.

The main purpose of a cool roof is to reflect the sun's radiant energy before it penetrates the interior of the building, thus reducing the amount of air conditioning needed to cool a facility3. A cool roof system is one that reflects solar radiation and also emits thermal radiation well4. Solar reflectance, or albedo, is the fraction of solar radiation reflected by a surface. Materials with high solar reflectance values absorb less of the sun's energy and therefore stay cooler, reducing daytime air conditioning requirements5. A cool roof can include any kind of reflective roof surface including lightly colored asphalt shingles, lightly colored ceramic tiles, or white acrylic roof coatings containing materials such as titanium oxide.



Another property of a cool roof is the material's emittance. Emittance is the amount of absorbed heat that is radiated from a roof. A higher emittance allows the roof material to release the heat it absorbs more quickly. A material with high solar reflectivity but a low emmitance (such as unpainted metal) causes the heat to be retained on the surface and ultimately transferred into the building 6. The combined value of solar reflectance and emittance is known as the Solar Reflectance Index (SRI). SRI is the roof's ability to reject solar heat. It is defined so that a standard black asphalt shingle has an SRI of zero (reflectance 0.05, emittance 0.90) and a white shingle has an SRI of 100 (reflectance 0.80, emmitance 0.90). A roof with high reflectance but low emmitance such as unpainted metal will have a low SRI under 50 7.

Because cool roofs reflect the sun's radiant heat in the winter as well as the summer, they have the possibility of causing more energy use for heating a facility. According to an article by Miller-McCune, this may be particularly true for climates in which the amount of heating degree days are significantly more than the amount of cooling degree days. The author goes so far to state that cool roofs may only be applicable to ASHRAE climate zones 1-3, which may be viewed here. Other climate zones may need to use additional insulation to negate the cool roof effects during the heating season.

The Lawrence Berkley National Laboratory Heat Island Group modeled energy use in buildings with cool roof technology in eleven metropolitan areas using a computer simulation and projected the energy savings taking into account the "penalty" of additional energy needed to heat the building in the winter. Energy savings projections in these cities alone range from 3 to 37 million dollars and totals 194 million dollars 8.

LEED Applications

Using a cool roof product in a LEED® project could potentially help earn points in various categories, including SS Credit 7.2 (Heat Island Effect – Roof), EA Prerequisite 2 (Minimum Energy Performance), EA Credit 1 (Optimize Energy Performance) and possibly others depending on the exact product.

There are many state and federal rebate programs for installing cool roofs. For more information on rebates in your area, go to Coolroofs.org.

The federal government has taken a big step in promoting cool roofs. This past summer, DOE Secretary Steven Chu directed all DOE offices to install cool roofs when replacing roofs or constructing new DOE facilities, when life cycle cost effective. He also issued a letter to other federal agencies requesting they do the same, and DOE issued a Guideline for Selecting Cool Roofs, found here.

To recap, the five things to be aware of when considering a cool roof are:

1. Heat Island Effect
2. Solar Reflectance Index
3. Rebates
4. LEED credits
5. Geographic considerations

While not applicable in every climate, cool roofs are an economical way to reduce energy usage and associated greenhouse gas emissions and will help contribute to several credits in a LEED® project. With the abundance of research that has been done on this technology with positive results, I believe cool roofing products should be considered in almost every green building project.