EF 11: REDUCE SUMMER HEAT WITH COOL ROOFS

New York City Building Code
Developed by the Site & Site Stormwater Committee

Summary

Issue:
Light-colored roofs reflect light and heat back into the atmosphere, thereby cooling buildings and cities. The building code mandates white roof coatings, but the standards are not aligned with LEED, which is used by many developers.

Recommendation:
Amend specifications for cool roof coatings to align them with LEED.

Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Section 1502 to include the following definitions:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMITTANCE</td>
<td>A measure of the ability of a surface material to release absorbed heat, determined as per ASTM 408 or ASTM C 1371.</td>
</tr>
<tr>
<td>INITIAL SOLAR REFLECTANCE</td>
<td>The solar reflectance of a material, measured when that material is first installed.</td>
</tr>
<tr>
<td>SOLAR REFLECTANCE</td>
<td>The measure of the ability of a surface material to reflect sunlight, including visible, infrared, and ultraviolet light, determined as per ASTM E 903, ASTM E 1918, or ASTM C1549.</td>
</tr>
<tr>
<td>SOLAR REFLECTANCE INDEX</td>
<td>A measure of the ability of a surface to reject solar heat that incorporates both solar reflectance and emittance, as determined by ASTM E 1980.</td>
</tr>
</tbody>
</table>

2. Amend Section 1504.8 as follows:

1504.8 Reflectance. Roof coverings on roofs or setbacks with slope less than three units vertical in 12 units horizontal (25 percent) shall be white in color or ENERGYSTAR as highly reflective for at least 75 percent of the area of the roof or setback surface.] At least 75 percent of the area of roofs and setbacks shall have a covering with a minimum solar reflectance index in accordance with Table 1504.8.

Table 1504.8

<table>
<thead>
<tr>
<th>Roof or Setback Type</th>
<th>Slope</th>
<th>Solar Reflectance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sloped</td>
<td>&lt;= 2:12</td>
<td>78</td>
</tr>
<tr>
<td>Steep-sloped</td>
<td>&gt; 2:12</td>
<td>29</td>
</tr>
</tbody>
</table>

Exceptions:
1. Any steep-sloped roof composed of copper, lead or tile, wood or slate shingles.
2. Terraces on setbacks comprising less than 25 percent of the area of the largest floor plate in the building.
3. Green roofs in compliance with Section 1507.16 shall be permitted to comprise part or all of the 75 percent required area coverage.
4. Roofs used as [outdoor] passive or active recreation space by the occupants of the building shall be permitted to be either landscaped or covered with a walking surface or other protective surface with [an albedo] an initial solar reflectance [index] of 30 percent or greater.
5. Ballasted roofs, provided that the ballast has an initial solar reflectance of 30 percent or greater.
6. Any portion of a roof that is under a planter, mechanical equipment, photovoltaic or solar thermal equipment or any other structure or equipment exempted by the commissioner.

3. Amend Section 1510.1 as follows:

1510.1 General. Materials and methods of application used for recovering or replacing an existing roof covering shall comply with the requirements of Chapter 15.
Supporting Information

Issue – Expanded

Cool roofs are an extremely cost-effective strategy to combat high peak demand for cooling and the urban heat island effect, which is the tendency of urban areas to be hotter than their suburban surroundings because of dark absorbent surfaces and a lack of vegetation. New York City began addressing these issues by incorporating a requirement for white roofs in its last code cycle. This proposal seeks to build on that requirement by better aligning with LEED. For instance, the Building Code allows “white” coatings and references “albedo”, whereas LEED measures reflectivity using solar reflectance index, which also takes into account transmittance. In addition, the Building Code only covers low-sloped roofs, while LEED covers both low- and steep-sloped roofs. Since roofs are replaced every 15 to 25 years, capturing re-roofing means that within 20 years, most of New York City’s low-sloped roofs will be cool roofs. It is estimated that this would decrease the City’s urban heat island effect by at least 1 degree F.

The proposal will have impacts on three levels. On an individual building level, installing cool roofs will lower the roof surface temperature and, consequently, the need for air-conditioning, especially during summer peaks. On a hot, sunny day, the temperature of a black roof can reach 90°F above the ambient air temperature (i.e. 180°F on a 90°F day). This is because non-reflective roofs absorb and retain solar energy as heat, which contributes not only to a hotter roof, but also to uneven thermal expansion/contraction and aging of the roof. The top floors of the building underneath are heated up by the hot roof, causing discomfort for the building inhabitants as well as increased local cooling loads, particularly in older buildings, which tend to have less insulation.

On a citywide level, this proposal will help mitigate the “urban heat island effect”. This is a major problem in New York City due to the preponderance of dark roofs (944 million square feet of roof surface) as well as dark surfaces on roads and parking areas -- together causing summer temperatures to be 5 to 8 degrees F hotter than surrounding areas. Installing light roofs on a large percentage of the city’s buildings will collectively reflect enough heat to cool down not only the individual buildings but the city.

On a global level, implementing the proposal will also help combat global warming. The heat from the infrared and near infrared components of solar radiation is readily absorbed by dark roofs and radiated back at night as infrared radiation, which is then trapped by the CO₂ blanket in the atmosphere. By locking in heat, this CO₂ layer warms up the Earth and its atmosphere -- the phenomenon of global warming. Light colored roof surfaces reflect more sunlight in the form of visible light rather than infrared radiation. Visible light does not get trapped by the CO₂ blanket but rather passes through it and thus does not contribute to the warming up of the atmosphere.

Environmental & Health Benefits

Implementing the proposal will have significant environmental and health benefits:

- **Cool roofs and cooler air temperatures** mean a cooler city and buildings and/or less energy consumed for air-conditioning purposes and consequently, lower carbon footprint.
- **Reduced energy consumption** during summer peaks of energy use, related to increased air conditioning requirements, will increase peak capacity and thus, help prevent frequent blackouts.
- **Cool roofs will reduce the heat island effect and minimize the impact on microclimate and human and wildlife habitat.** Lowering urban heat will also mitigate air pollution caused by the increased emission of nitrous oxides, sulphur dioxide and carbon dioxide associated with the increased energy use for cooling purposes. These pollutants combine photochemically in the presence of sunlight and heat and produce ground level ozone (smog), which is a health hazard. Reducing the heat island effect by installing light roofs will slow down this process, which occurs much more readily at the higher temperature.
- **Reducing urban heat will also prevent life loss during extreme heat.** A 1995 heat-wave in Chicago is estimated to have killed over 700 people – over twice as many as perished in the infamous Chicago Fire of 1871. Many of those who died were low-income persons who did not have air-conditioning and were unable to protect themselves from the ambient temperatures. Even more shocking was the European heat wave of August 2003, which is estimated to have claimed the lives of 35,000 people, with over 14,000 dying in France alone.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have no significant positive health impact.

Cost & Savings

This proposal is not expected to have any significant impact on capital costs.
Precedents

New York City placed cool roof requirements in the last iteration of the New York City Building Code.

City of Chicago’s energy code requires that roof installations on most commercial low-sloped air-conditioned buildings meet SRI criteria.

State of Georgia “Georgia White Roof Amendment” requires the use of additional insulation for roofing systems whose surfaces do not have SRI test values of 0.75 or more.

California’s Title 24 of the Energy Code requires the installation of cool roofs and California’s Cool Savings Program provides rebates to building owners for installing roofing materials with high SRI values.

LEED

This measure is applicable to:

- LEED CI-SS cr.1 Option E: Heat Island Reduction, Roof (1/2 point);
- LEED NC-SS cr.7.2: Heat Island effect, Roof (1 point);
- LEED EB-SS cr. 6.2 Heat Island Reduction, Roof (1 point).

Each rating system provides various options for achieving LEED points. Compliance with the code requirements of this new proposal may assist in achieving these LEED credits, provided that certain additional provisions are met.

This proposal does not include steep sloped roofs. The NYC building code and LEED have differing criteria for defining low vs. steep roof slopes; therefore calculations for and compliance with solar reflectance will vary accordingly. Additionally, LEED does not differentiate roofs used as outdoor recreation spaces.

The proposal is consistent (for low sloped roofs) with LEED 2009 language currently under consideration.

ENERGYSTAR products do not automatically achieve credits under LEED.

Implementation & Market Availability

There are no known implementation issues associated for this proposal.

Green roofs or roofs with high Solar Reflectance Indexes reduce costs associated with cooling and HVAC equipment. Green roofs typically require an additional up-front investment, while cool roofs may or may not cost more than other roofs. However, any up front investment is likely to result in energy cost savings throughout the lifecycle of the project.

This proposal would not unduly limit the use of wood or other decking as only 75% of a roof surface must comply with the SRI requirements and the NYC Fire Code already restricts the use of wood decking to not more than 30% of the roof surface.

ENDNOTES:


2 Ibid.