LANDSCAPED ROOF SYSTEMS

by
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The Louisiana State Capitol has a green or landscaped roof system over subterranean House Committee meeting rooms (east side) and Senate Committee meeting rooms (west side). The idea to place the committee rooms below grade with a landscaped roof system was aimed at two distinctly different paths of logic. The obvious path is to save the energy which would be lost through exterior walls and a roof. The less obvious reason had to do with the historic significance of the 1931 Capitol's high rise structure. If the flanking meeting rooms were on or above grade, they would greatly change the massing of the bicameral house and senate chambers. By placing these additions underground and landscaping the roof, no changes to the lines and proportion of the existing building would be created. Additionally, the park like grade treatments on the east and west gives serenity as well as deference to the important work taking place inside the Capitol daily. Thus, the energy savings is almost a bonus along with gaining the necessary additional space and preserving the integrity of this National Historic monument.

Louisiana State Capitol 1931[1]

Louisiana State Capitol – Green roof over subterranean house committee meeting rooms[1]

[1] Photograph provided by Harvey Landry, LDNR.

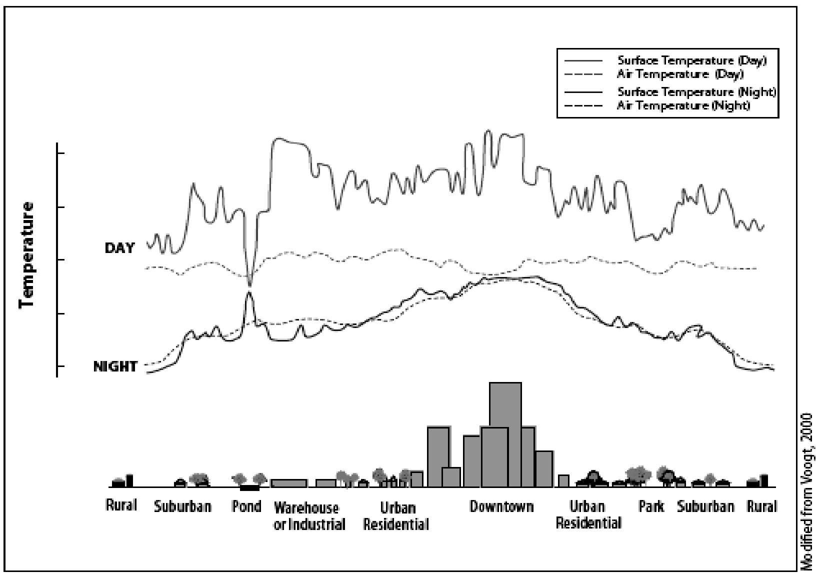
The National Roofing Council of America (NRCA) is beginning to use the term "landscaped roof systems" in lieu of "green roof systems" to prevent confusion in the building industry. Others may also be using the term "vegetative roof." Landscaped roof systems require the combination of roofing concepts and waterproofing concepts. A landscaped roof system is a wet environment, and a waterproofing membrane is mandatory. Roof system details are modified to accommodate growth medium and green components. On a typical low slope roof (≈1/4"/ft slope), the insulation would be found under the waterproof membrane. NRCA recommends a waterproofing membrane be adhered with insulation above it. Therefore, a landscaped roof system membrane is thermally stabilized and protected from damage and puncture by the insulation itself. However, in the case of green or landscaped roofs, the turf or planting will be at the surface, with soil drainage created by crushed stone or gravel below the plants, but above the rigid insulation which sits on top of the waterproof membrane at the lowest level. Positive drainage is strongly recommended. Water must be free to drain from all of the planted area, to collect at common points, and to be directed away from the building. There may be other areas designed specifically to hold the water for use by the planting.

Advantages of Landscaped Roofs	*Disadvantages of Landscaped Roofs*
• **Environmentally friendly.**	• **Increased roof weight may require increased structural member sizes and cost.**
• **Can create usable outdoor space.**	• **Safety/liability may be an issue for public access.**
• **Increases thermal efficiency of the building.**	•
• **Reduces HVAC equipment and operating cost.**	•
• **Reduces interior noise levels.**	•
• **Extends roof membrane service life.**	• **If a roof membrane leak does occur, it may be difficult to locate.**
• **Provides storm-water management, aesthetic benefits, rating system benefits (e.g., LEED™ and Green Globes).**	• **Cost to repair roof and then to replace living flora and soil above may be very high by comparison.**
• **Reduces rooftop temperatures.**	•
• **Mitigates urban heat islands.**	•

The Green Roofing Energy Efficiency Tax Act, (GREETA), March 2009, was bipartisan legislation to create green jobs and protect the environment. GREETA provides a solution to a problem that restricts the movement toward energy-efficient roofing products in the commercial building sector, a major source of carbon emissions. The problem is the Internal Revenue Code requires that commercial roofs be depreciated over a 39-year schedule. A study by Ducker Worldwide, a leading industrial research firm, found that the average life span of a commercial roof is only 17.5 years. This disparity is a major disincentive for building owners to replace older failing roofs with new green roof systems. GREETA will address this problem by allowing building owners to use a 20-year depreciation schedule for roof systems that meet the benchmark ASHRAE 90.1 energy-efficiency standard (set by the American Society of Heating, Refrigerating and Air-Conditioning Engineers). GREETA is projected to begin generating new "green-collar" jobs in the U.S. manufacturing and construction industries while also helping to conserve energy and enhance the environment by reducing carbon emissions. By accelerating demand for technologically advanced green roof systems, GREETA is estimated to:

- Create 40,000 new green jobs among roofing manufacturers and contractors
- Add $1 billion of taxable annual revenue from the roofing industry
- Reduce carbon emissions by more than 20 million pounds annually
- Reduce U.S. energy consumption by 13.3 million kilowatt hours annually
- Save small businesses billions of dollars through a simpler and more equitable system of taxation

As urban areas develop, changes occur in their landscape. Buildings, roads, and other infrastructure replace open land and vegetation. Surfaces that were once permeable and moist become impermeable and dry.[2] These changes cause urban regions to become warmer than their rural surroundings, forming an "island" of higher temperatures in the landscape. Communities can take a number of steps to reduce the heat island effect, and creating landscaped roof systems is one of the strategies.



Surface and atmospheric temperatures vary over different land use areas.

Heat islands occur on the surface and in the atmosphere. On a hot, sunny summer day, the sun can heat dry, exposed urban surfaces, such as roofs and pavement, to temperatures 50–90°F (27–50°C) hotter than the air, while shaded or moist surfaces—often in more rural surroundings—remain close to air temperatures.[3] Surface urban heat islands are typically present day and night, but tend to be strongest during the day when the sun is shining. In contrast, atmospheric urban heat islands are often weak during the late morning and throughout the day and become more pronounced after sunset due to the slow release of heat from urban infrastructure. The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings.[3] On a clear, calm night, however, the temperature difference can be as much as 22°F (12°C).[3] Surface temperatures vary more

[2] Reducing Urban Heat Islands: compendium of Strategies. Environmental Protection Agency

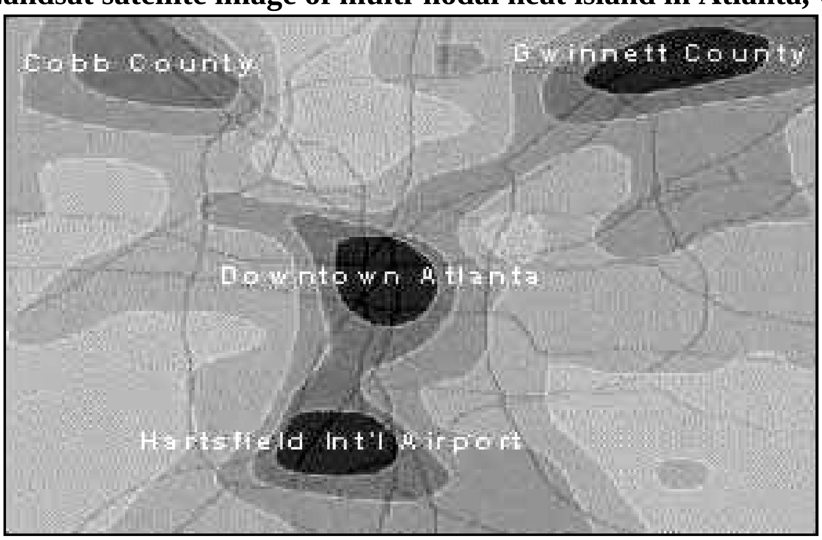
[3] Trenberth, K.E., P.D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J.A. Renwick, M. Rusticucci, B. Soden and P. Zhai. 2007. Observations: Surface and Atmospheric Climate Change. (PDF) (102pp, 24MB)

than air temperatures during the day, but they both are fairly similar at night. The dip and spike in surface temperatures over the pond show how water maintains a fairly constant temperature day and night, due to its high heat capacity.

Elevated temperature from urban heat islands, particularly during the summer, can affect a community's environment and quality of life. While some heat island impacts seem positive, such as lengthening the plant-growing season, most impacts are negative. Higher temperatures in summer increase energy demand for cooling and add pressure to the electricity grid during peak periods of demand. One study estimates that the heat island effect is responsible for 5% - 10% of peak electricity demand for cooling buildings in cities. Increasing energy demand generally results in greater emissions of air pollutants and greenhouse gas emissions from power plants. Higher air temperatures also promote the formation of ground-level ozone. Warmer days and nights, along with higher air pollution levels, can contribute to general discomfort, respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke, and heat-related mortality. Hot pavement and rooftop surfaces transfer their excess heat to storm water, which then drains into storm sewers and raises water temperatures as it is released into streams, rivers, ponds, and lakes. Rapid temperature changes can be stressful to aquatic ecosystems.

Surfaces emitting thermal energy do so in the infrared wavelengths. Instruments on satellites and other forms of remote sensing can identify and measure these wavelengths, providing an indication of temperature. By using radiometers mounted on aircraft or a satellite, researchers can easily collect many surface observations. The National Aeronautics and Space Administration (NASA) conducted flyovers using an aircraft-mounted sensor in many cities, including Baton Rouge, Sacramento, and Salt Lake City. Several cities also use Landsat satellite data to classify land cover and identify heat islands. The Landsat 7 satellite, a U.S. satellite used to acquire remotely sensed images of the Earth's land surface and surrounding coastal regions, provides information from which researchers can derive surface temperatures and evaluate heat islands.[4]

Landsat satellite image of multi-nodal heat island in Atlanta, GA



[4] The Landsat 7 satellite was launched in 1999 and was designed to last five years. It continues to function at diminished capacity. The Landsat Data Continuity Mission, scheduled to be launched in 2011, will be the next satellite in the Landsat series.