Environmental and Cost Benefits of High Albedo Concrete

By Erin Ashley, PhD, LEED AP, Director of Codes and Sustainability, NRMCA

The use of light colored exposed concrete in our urban areas and roadways can aid in the overall energy savings, safety, comfort and ambience of the general public. This is a guiding principle of Low Impact Development (LID). Light colored concrete absorbs less heat and reflects more light than dark-colored materials, therefore maintaining a low surface temperature. High albedo concrete has been demonstrated to have a positive impact on the localized ambient temperatures and can reduce energy requirements to cool buildings. Light colored pavements also require less site lighting to provide safe night-time illumination levels, whether on parking lots, driveways or sidewalks. Less sight lighting requires less energy. The net effect from light colored surfaces does result in a reduction in energy to help reduce the environmental impact of our built environment.

Concrete's ability to reflect solar radiation is governed by the material's albedo or measure of the solar reflectivity of the material. An object's albedo is the extent to which the material diffusely reflects light from the sun. Although not always an indicator, materials with a light color have a high albedo, where materials that appear darker typically have a lower albedo. A material's ability to reflect infrared light is directly proportional to a material's ability to reflect heat from the surface. During the hot summer months, the ambient air surrounding dark colored paving or cladding materials can be up to 10 °F warmer[1] than material with a light color, or high albedo. Several studies have been made which illustrate this point. One such study analyzed temperature differentials in California at an ambient temperature of 55 °F for various colored materials[2]. The study found that the maximum temperature differential between a material covered with a black acrylic paint and a material covered with a white acrylic paint was 68°F. A second study measured the temperature of various pavement types during a hot 90°F summer day, and found that weathered concrete had a temperature of 155°F at the material surface where dark asphalt had a temperature of 195°F, 40 degrees higher than the lighter colored concrete pavement.[3]

The effect of increase in ambient temperatures in metropolitan areas is apparent when you compare the health of those who reside in the city versus those who reside in more rural areas. Compared to rural areas, cities experience higher rates of heat related illness and death. Heat islands, or areas of dark colored roofing and pavements where ambient temperature is increased, can exacerbate hot weather events or periods, which may cause heat stroke and lead to physical discomfort, heat stroke, organ damage and even death – especially in vulnerable populations such as the elderly[4]. The Centers for Disease Control and Prevention (CDC) says that excessive heat claims more lives in the United States each year than hurricanes, lightning, tornadoes, floods and earthquakes combined. Between 1979-1998, the CDC estimates that 7,421 deaths resulted from exposure to excessive heat in the U.S. By reducing the temperature of the pavements through the use of concrete, one may be able to reduce the ambient temperature of our cities, therefore reducing the temperature exposure to its residents, as shown in Figure 1. This idea is further solidified when you look at one of 13 "cool communities" sponsored by the Department of Energy[5]. By simply replacing

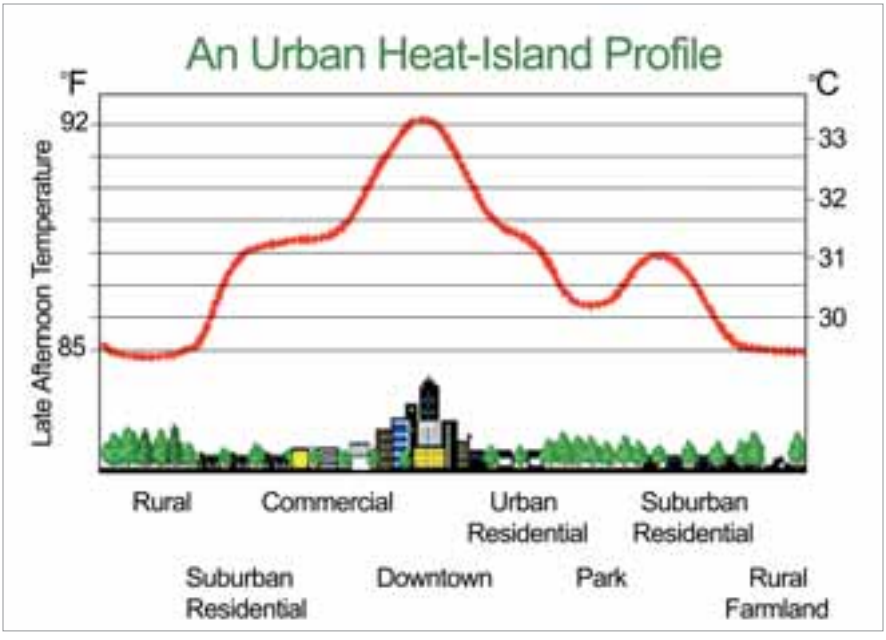

Figure 1. Urban Heat Island Effect for various localities [6]