PROCEEDINGS
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Reflective Roofing Research: The Influence of Roof Color on Adjacent Air and Surface Temperatures

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Abstract

The design of a roof system has important ramifications beyond the performance of the roof itself. To help answer emerging questions about the thermal effects of roof color on the neighboring built environment, a research project was conducted by the Center for High Performance Environments at Virginia Tech with the support of the RCI Foundation. Black ethylene propylene diene monomer (EPDM) and white thermoplastic polyolefin (TPO) membrane overlay areas on an existing roof were instrumented with temperature sensors. The study tested the relationship between roof color and resulting temperatures on roof surfaces, in the air above roof surfaces, on electrical metallic tubing (EMT) above roof surfaces, and at adjacent opaque and glazed wall surfaces.

At each location of interest, three temperature sensors were installed to ensure replication. Roof membrane surface temperatures were taken by embedding a temperature sensor in thermal compound and covering it with a self-adhering flashing patch of the same material as the underlying roof membrane. For sensors measuring air temperature, radiation shields with solid bases were employed and placed at 3.0, 5.5, 9.0, and 34 inches above the roof surface. Temperatures at EMT were taken at the same four heights as the shielded air temperature sensors. Opaque wall and glazing sensors were placed at heights of 22, 34, 53, and 64 inches.

Summarized results and conclusions from data gathered on March 8, May 24, and August 12, 2016 are summarized below. *[Editor's note: The entire paper is not published herein due to the authors' copyright agreements with other publications in which the materials are being published. These details, however, will be presented in the presentation itself.]*

The surface of the EPDM roof was significantly hotter than the surface of the TPO roof on both May 24 and August 12, with an average difference of 64° and 47°F, respectively. On both of these dates, air temperatures were significantly hotter above the EPDM roof than the TPO roof, by roughly 4°F at 3.0 inches above the roof, and 3°F at 5.5 inches above the roof. Above 5.5 inches, air temperature differences between EPDM and TPO treatments were not found to be significant. On both May 24 and August 12, statistically significant temperature differences were evidenced at some, but not all, of the EMT locations. Where significant, temperatures were 3 to 4°F higher at EMT placed above the TPO surface than above the EPDM. On May 24, three of the four heights (all but 34.0 inches) on the precast concrete panel wall were 6 to 9°F warmer adjacent to the TPO roof than adjacent to the EPDM roof. On August 24, one significant difference of nearly 6°F occurred at 64.0 inches. Exterior glazing surface temperatures were tested on a separate day from the rest of the building elements due to the shading of the glass from roof reflections during the warm half of the year. Temperatures measured on March 8, 2016, were found to be approximately 3°F hotter adjacent to the TPO overlay as compared to the EPDM overlay area at all heights measured.

Speakers

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ELIZABETH GRANT is an associate professor at the School of Architecture + Design at Virginia Tech. She is a registered architect, a member of RCI, and the associate director of the Center for High Performance Environments. She has published in *RCI Interface*, the *Journal of Architectural Engineering*, and the *Journal of Green Building*. Her interests include environmentally sensitive design, the building envelope, and building systems integration.

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KENNETH BLACK is a doctoral candidate in architecture and design research at Virginia Tech, and is working with the Center for High Performance Environments. He holds bachelor of architecture and master of science degrees from Virginia Tech. Black's research focuses on vegetated assemblies and the building envelope and its interaction with design pedagogy.

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