RSI
ROOFING / SIDING / INSULATION

The Name to Build On
SEPTEMBER 2005 / www.RSImag.com

COOL ROOFING Confusion!

SEMINAR OFFERS POLARIZING VIEWS OF REFLECTIVE ROOFS

A ĈUESTEX PUBLICATION

Raising the Energy Bar / Spectrally Selective Window Film / The Value of Home Insulation

COOL ROOFING CONFUSION!

Atlanta conference offers polarizing views of 'cool roofs'

BY PAUL R. BERTRAM, JR., FCSI, LEED AP, RCI

Ask a roofing consultant for the definition of a "cool roof" and chances are that you'll get a different interpretation from each individual. This marketplace confusion prompted the Roofing Consultants Institute (RCI) Foundation to organize a major symposium, "Cool Roofing - Cutting through the Glare," this summer in Atlanta.

Progress often breeds confusion. This was a concern expressed by RCI president Tom Hutchinson, who worries about inconsistent use of terminology, such as environmentally-friendly roofs, energy efficient roofs, green roofing, garden roofing, sustainable roofs and urban roof heat island effect.

Hutchinson also asked rhetorically, what are realistic scientific formulated reflectance values? Does anyone know the short-term and long performance of a highly reflective roofing system compared to the performance paybacks seen with a white roof in the area? Has anyone compared energy efficiency, maintenance expenses and durability? The answers to these are further muddled by disconnects between two government energy calculation tools, one from the DOE (Department of Energy) developed by Oak Ridge National Laboratory and the other, the EPA Energy Star calculator. They often differ in agreed results and benefits.

Emissivity is also an important factor for calculating energy efficiency. However, the calculation tools are missing emissivity in their formulas, Hutchinson suggested.

Impacts of roof design resulting from government mandates, codes changes and focus on singular attributes, such as "reflective" roofs—with little input from licensed roofing consultants and sometimes at the expense of roof systems engineered for specific project performance—were of concern from a liability perspective.

The economics of cool roofs

"Even though more and more tools are available to make energy saving decisions, there are potential misunderstandings from disparities in these tools, creating a need to seek additional approaches in roof performance evaluation," explained Jim Hoff, chairman of ERA (The EPDM Roofing Association).

Hoff's presentation on the Economics of Cool Roofing included data from a recent study using the DOE Cool Roof calculator that demonstrated two graphic representations of the geographic variation in reflective roofing energy savings of 40 cities. The calculations were based on inputs of local climate conditions, local energy costs, roof reflectance and emittance (using ASHRA E 90.1), heating and cooling system efficiency, roof system R-value and roof system size.

The study results cited by Hoff show that geographical climate, combined with the effects of local energy prices, vary in the degree of realistic energy savings or energy losses of reflective roofs. There is supporting data that shows that a generalization for the use of a highly reflective surface for areas of the country where solar radiation is not a significant climate factor might actually cause a negative energy impact.

The "Cool Roofing - Cutting through the Glare" symposium was hosted in Atlanta last May by the RCI (Roofing Consultants Institute) Foundation.

As an example, the "reflective" roof mandate in Chicago might be better stated as heat island reduction, so as not to eliminate proven roofing materials with lower reflectivity attributes. Limitations of Hoff's study assumed energy prices to be constant, but it was noted that in fact many areas of the country experience significant spikes at certain times of the year.

Solutions to the heat island effect can also fall into a well-intended and singularly focused trap because empirical data and measurable performance outcomes have not been fully explored. The U.S. Green Building Council's LEED Rating System promotes "White" roof or "Garden roof" but building teams need more data before claiming they have addressed the heat island effect.

Hutchinson declared a notable absence of any cost/benefit analysis in public policy discussions about reflective roofs, especially in the areas of reflective roof maintenance and displacement of certain products from the market. Evaluating all the empirical data allows an informed decision process to determine trade-offs necessary to achieve the requirements of the project's roof design.

"Even though more and more tools are available to make energy saving decisions, there are

potential misunderstandings from disparities in these tools, creating a need to seek additional approaches in roof performance evaluation," explained Jim Hoff, chairman of ERA (The EPDM Roofing Association).

Urban heat island effects

To help clarify the measurable effects of urban heat islands, Jeffery Luvall, Ph.D. presented data obtained from aircraft using an Advanced Thermal and Land Applications Sensor (ATLAS) scanner technology to measure, map and model surface energy budget characteristics of surfaces typical of urban landscape for Baton Rouge, Salt Lake City and Sacramento.

He explained that urban heat island results from the energy that is absorbed during the day by man-made materials and is released at night resulting in the heating of the air within the urban area. He noted that surface temperature is a major component to the surface energy budget. Data from this study reported that each city had a distinctive "energy print" that is characteristic of surface composition and how it is absorbs the sun's energy.

Eva Wong of the Heat Island Reduction Initiative (HIRI) presented details of a specific heat island mitigation project. She mentioned the Philadelphia Energy Coordinating Agency (ECA) that launched the Cool Homes program to help senior citizens, at risk of experiencing health problems or death related to extreme heat. The program included applying cool roof coatings, which were found to reduce ceiling level temperatures of the top floor by 5° F.

Peter Turnbull, senior program manager with Pacific Gas and Electric Company explained how California was in search of a credible rating system with respect to the radiant properties of roof surfaces (or surface reflectance performance) and energy impacts associated with those properties.

Early attempts in the 1980s were finalized in 1998 with the formation and funding of the Cool Roof Rating Council. The need emerged in part from the implementation of California Title 24. Under this proposal, cool roofs will be considered a prescriptive requirement for nonresidential buildings with low-sloped roofs (i.e., roofs with a slope of 2":12" or less).

The proposed measure promotes the use of cool roofs to reduce cooling energy usage and peak electrical power demand in air-conditioned buildings regulated by Title 24.

Prior research indicated savings are greatest for buildings located in climates with long cooling seasons and short heating seasons, particularly those buildings that have distribution ducts in the plenum, cool-coatable distribution ducts on the roof, and/or low rates of plenum ventilation (Akbari et al., 1999; Konopacki and Akbari, 1998).

Another factor adding to the confusion of roofing reflectivity performance is the question of the effects of aging. Experiments conducted at LBNL (Lawrence Berkeley National Laboratory (http://www.lbl.gov/) as reported by Hashem Akbari Ph.D., basically showed that a simple cleaning allowed PVC samples to regain a substantial part of their original reflectivity. The clear message in

this presentation was that most white roofs must be cleaned periodically in order to retain significant reflectivity. Cleaning is another life-cycle costing factor that must be added into the reflectivity evaluation.

Cleaning cool roofs

David Roodvoets, presented a session on Economic Feasibility of Cleaning Roofs to Maintain their "solar reflectance" ratings. The opening statement of his session was a reality that few would deny: "Traditionally, very few roofs are cleaned during their lifetime."

He later discusses the life-cycle costing comparisons of energy savings compared to cleaning costs (or negative effects of reduced reflectivity), the value performance of insulation, and long-term reflective performance. He cautions about the environmental benefits of high reflectance roof energy savings being totally lost if the system quickly loses reflectance.

Dick Gillenwater of Carlisle SynTec presented an interesting study quantifying the energy savings of a ballasted roofing system compared to that of "cool" roof membranes. The study investigated the reflectivity and thermal performance of single-ply membranes when exposed to the outdoor environment. Areas explored included stone reflectivity verses stone mass and impact on heat flow, and thermal performance of ballast verses reflective membranes.

To date, the study is indicating that a ballasted roof system with reflectivity of 0.21 does not meet the Energy Star reflectivity criteria but performs at the same level of thermal performance as the rated Energy Star products. Three distinct assemblies are being studied: black surfaced membrane, ballast, and the white surfaced membrane.

The goal is to complete the data collection for a year through the second summer, model the stone characteristics for use in energy calculators for thermal conductivity and volumetric heat capacity. Ultimately, this data will quantify ballast performance against the Energy Star requirements and determine if there is a time-delayed value for energy cost savings.

Garden roofs

Karen Liu, from the National Research Council of Canada, presented a study on green roofs from the perspective of heat island reduction benefits. It was pointed out that in addition to the aesthetic appeal of a green roof, natural rooftop landscapes lower surface temperatures and provide thermal performance. Monitoring of two in-service extensive green roofs in Toronto showed that green roofs were effective in reducing heat gain in the summer, thus providing cooling effects for the buildings.

Dick Gillenwater of Carlisle SynTec presented an interesting study. It indicated that a ballasted roof system with reflectivity of 0.21 does not meet the Energy Star reflectivity criteria but performs at the same level of thermal performance as the rated Energy Star products.

However, the extensive roofs were not as thermally efficient in the winter. By definition, Extensive Green Roof Systems are lightweight shallow growing mediums consisting of small plants largely of native, low maintenance vegetation; while an Intensive Green Roof System is heavyweight and contains more garden soil. The increased soil depth allows for the growing of larger plants and trees.

The symposium brought to light many of the potential benefits of a highly reflective roof but additionally confirmed why there is confusion in the industry. Observations from this symposium confirm the need to explore all possible empirical data, energy calculations and the calculation of life-cycle costing analysis.

Evaluation of the empirical data is going to require more research and education to understand the differences of the reported data. There also needs to be a distinction between mandates for highly reflective roofs verses reduction of heat island effect and energy efficiency.

Roofing contractors will need to better understand the installation methods and materials for each of these "cool roof" applications. Roofing specifications will need to have greater clarity and are recommended to be more detailed than notes on the drawings. Manufacturers and related associations are advised to provide more education on system performance and installation differences.

Roofing consultants will need to evaluate and design roof systems that perform to given intended design requirements. In some cases, the designer may find the recommended roof design is in conflict with local code or government mandated roof initiatives and will need to understand liability implications.

"The fact is that there are countless issues that remain in considering the appropriate roof system, and this reflectivity "mantra" has not been explored fully enough at this point," said Jared Blum, president of the Polyisocyanurate Insulation Manufacturers Association (PIMA). **RSI**

Author Paul R. Bertram, Jr., FCSI, LEED AP, RCI is president and CEO of PRB Design in Orlando, FL. Since 1978, the company has specialized in developing sustainable/green strategies for manufacturers and the building team. He is a Fellow of The Construction Specifications Institute and currently serving as an Institute industry vice president. Bertram is also a member of: the Construction Writers Association, National Institute of Building Science, an Allied member of AIA, and Committee chairman of ASTM - E 2129.

Web sites

http://www.coolroofs.org

Product Rating Program

At the core of the CRRC is its Product Rating Program, in which roofing manufacturers can label various roof surface products with radiative property values rated under a strict program administered by the CRRC. Code bodies, architects, building owners and specifiers can rely on the rating information provided in the CRRC Rated Products Directory.

http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsCalculators.html

http://www.nerc.org/documents/Blank_NERC_EB_Calculator.xls