Session X-A: Thermal Performance I

Wednesday, December 8, 2004
1:30 p.m. to 3:00 p.m.
Grand Ballroom – Beach

Session Chair:

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1:30 p.m. to 1:40 p.m. Introduction
Merle McBride

1:40 p.m. to 2:00 p.m. *"Special Infrared Reflective Pigments Make a Dark Roof Reflect Almost Like a White Roof"*
William Miller

2:00 p.m. to 2:20 p.m. *"Comparison of Cathedralized Attics to Conventional Attics: Where and When Do Cathedralized Attics Save Energy and Operating Costs"*
André Desjarlais

2:20 p.m. to 2:40 p.m. *"Effect of Drying Protocols on Measurement of Sorption Isotherms of Gypsum Building Materials"*
Ken Wilkes

2:40 p.m. to 3:00 p.m. *"Probabilistic Modeling of Dynamic U-Factor"*
Krystyna Pietrzyk

Special Infrared Reflective Pigments Make a Dark Roof Reflect Almost Like a White Roof

William Miller and André Desjarlais – *Oak Ridge National Laboratory*

Kenneth Loye – *FERRO Corporation*

Scott Kriner – *Metal Construction Association*

Robert Scichili – *BASF*

Hashem Akbari, Ronnen Levinson, and Paul Berdahl – *Lawrence Berkeley National Laboratory*

Steve Weil – *Cool Roof Project with CEC*

Pigment colorant researchers are developing new complex inorganic color pigments that exhibit dark color in the visible spectrum and high reflectance in the near infrared portion of the electromagnetic spectrum. The new pigments increase the near infrared reflectance of exterior finishes and paints, thereby dropping the surface temperatures of roofs and walls, which, in turn, reduces the cooling-energy demand of the building. However, determining the effects of climate and solar exposure on the reflectance and the variability in color over time is of paramount importance for promoting these energy efficiency benefits and for accelerating the market penetration of products using the new color pigments.

Comparison of Cathedralized Attics to Conventional Attics: Where and When Do Cathedralized Attics Save Energy and Operating Costs?

André O. Desjarlais, Thomas W. Petrie, and Therese Stovall – *Oak Ridge National Laboratory*

Significant energy losses associated with HVAC ductwork located in a house attic have resulted in a proposed attic design called the “cathedralized attic.” In this design, the attic floor insulation is replaced by insulation located against the bottom of the roof deck, and no outside ventilation to the attic space is permitted. This approach offers both advantages and disadvantages. Previous researchers have reported on how these attics perform in hot, dry climates using a whole building simulation tool. The analysis reported here uses a computer model of heat transfer within the attic space to examine the net effect of this approach compared to a traditional attic in six different climates. Parametric analysis was used to explore the effect of climate, varying levels of attic insulation, and different duct details. These duct details included length, leakage rate, insulation level, and HVAC run time. The computer model includes radiative heat exchange, as well as conductive and convective heat transfer modes and has been previously benchmarked against experimental data.

Effect of Drying Protocols on Measurement of Sorption Isotherms of Gypsum Building Materials

Kenneth E. Wilkes, Jerald A. Atchley, and Phillip W. Childs – *Oak Ridge National Laboratory*

Sorption isotherms of a number of gypsum building materials have been measured using different drying protocols. The results show that the isotherms are sensitive to the initial drying conditions. The current ASTM test method recommends that gypsum materials be dried at 40°C (104°F), but the drying relative humidity is not specified. The intent of the relatively low drying temperature is to remove the hygroscopically bound water and to prevent the loss of chemically bound water. It was found that drying at 40°C (104°F) and about 0.2% relative humidity in an oven flushed with dry air results in loss of the chemically bound water, while drying at 40°C (104°F) and 11-12% relative humidity in a vented oven does not sufficiently dry the material. Drying at 23°C (73°F) and ~0.5% relative humidity as obtained in an oven or enclosure flushed with dry air or in a desiccator is recommended for these types of materials.

Probabilistic Modeling of Dynamic U-Factor

Krystyna Pietrzyk and Carl-Eric Hagentoft – *Chalmers University of Technology*

A probabilistic model of thermal transmittance (U-factor) for a building with lightweight construction is presented. Steady-state conditions of airflow and heat flow through the structure are assumed. Three cases, dependent on the direction of the airflow through the envelope, are considered: tight envelope, infiltration, and exfiltration. Thermal transmittance is treated in the model as a random variable varying with the changes of microclimatic conditions at the site of a building.

As an example, the test house situated in two different climatic zones is considered. The probability density functions of U-factor are approximated on the basis of probability density functions of climatic parameters and the air change rate. First-order reliability method (FORM) techniques are used as a tool for the probabilistic approximation.