Session VIII-B: Indoor Environment

Wednesday, December 8, 2004
8:30 a.m. to 10:00 a.m.
Grand Ballroom – Palm

Session Chair:
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8:30 a.m. to 8:40 a.m. Introduction
Gary Proskiw

8:40 a.m. to 9:00 a.m. *"ASHRAE'S First Residential Ventilation Standard"*
Max Sherman

9:00 a.m. to 9:20 a.m. *"Window Energy Analysis Using Occupant Comfort as the Guidelines"*
Phil Kerrigan

9:20 a.m. to 9:40 a.m. *"An Evaluation of Thermal Comfort in Typical Modern Low-Income Housing in Malaysia"*
John Tinker

9:40 a.m. to 10:00 a.m. *"Field Evaluation of the Moisture Balance Technique to Characterize Indoor Wetness"*
Paul Francisco

ASHRAE'S First Residential Ventilation Standard

Max Sherman – *Lawrence Berkeley National Laboratory*

ASHRAE has recently published its first ventilation standard dedicated solely to residential applications—Standard 62.2-2003 (although Standard 62-1989 did mention residential application). This standard defines the roles of, and minimum requirements for, mechanical and natural ventilation systems and the building envelope intended to provide acceptable indoor air quality in low-rise residential buildings. The standard includes a minimum whole-house ventilation rate, local exhaust rates, and other kinds of source control. This paper summarizes the standard and indicates the key issues. Providing acceptable indoor air quality often depends more on source control than on ventilation itself. Source control depends on the interactions between ventilation and the building envelope. Unbalanced ventilation systems combined with a tight envelope can lead to building pressurization or depressurization. Building pressures can mitigate or enhance heat and mass transport through the building envelope, which can impact both energy use and moisture performance. These pressures can also impair systems and components not directly tied to ventilation, such as the operation of combustion appliances or entrainment of soil gas. Such "house-as-system" issues were important considerations in the development of the standard and will be discussed in this paper. ASHRAE is continuing to develop and enhance these efforts by using a continuous maintenance process for the standard and by creation of a companion guideline to reflect the state of the art.

Window Energy Analysis using Occupant Comfort as the Guideline

Phillip Kerrigan, Jr. – *Building Science Corporation*

James Larsen – *Cardinal Glass Industries*

Windows historically have been the poorest performing elements of the building envelope. High heat loss during winter weather exposes the building occupant to cold interior glass surfaces. High solar gain in the spring, summer, and fall can lead to serious overheating on sunlit elevations. Today s high performance window systems greatly improve on cold weather comfort but the designer must still choose the appropriate level of solar gain for year round performance.

Common practice in building energy simulation work is to assume fixed thermostat settings, regardless of the components used in the thermal envelope. If the resulting design is uncomfortable the occupant s likely first response is to change the thermostat setting, which can invalidate the original energy analysis. At the very least, a building design should not be considered energy efficient unless it delivers adequate comfort as well.

This paper will detail how window comfort modeling can be used to more accurately analyze the energy impacts of building occupant discomfort. With this perspective the building designer can avoid common errors made during trade-off efforts to optimize the structure for both first cost and operational cost. The calculations give the designer a tool to evaluate the comfort impact of window selection during the low energy spring and fall swing seasons. And finally; a comfort analysis of windows gives the designer the confidence that the building will be energy efficient under real user conditions, and that the building occupants can point to that efficiency having tangible comfort benefits all year-round.

An Evaluation of Thermal Comfort in Typical Modern Low-Income Housing in Malaysia

J.A. Tinker – *University of Leeds*

S.H. Ibrahim – *University of Malaysia Sarawik*

E. Ghisi – *Federal University of Santa Catarina*

Malaysia is facing a serious housing shortage in urban areas. To meet the demand, particularly for low-income families, the government and private corporations have launched massive building programs. Most of the housing being built is totally unsuitable for a hot and humid climate and, consequently, the houses are thermally uncomfortable most of the time. Unlike the modern houses currently being built, traditional Malay houses are designed to suit the climate and hence provide comfortable living conditions.

A study conducted by the authors was an important prototype, comparing a traditionally built house and a typical modern "modular" low-income house built in Sarawak, East Malaysia. Thermal comfort parameters were measured in both houses. The data were evaluated using a computational fluid dynamics (CFD) code and the comfort levels were assessed using the Corrected Effective Temperature (CET) Iindex method.

The provisional research confirmed that the traditionally built Malay house provided good levels of thermal comfort while the modern "modular" house did not. The work identified the critical need for some form of permanent ventilation to be provided in the modular house in order to improve its thermal comfort provision.

Field Evaluation of the Moisture Balance Technique to Characterize Indoor Wetness

William B. Rose and Paul W. Francisco – *University of Illinois at Urbana-Champaign*

As part of the HUD Healthy Homes Initiative, a campaign was initiated to monitor the temperature and humidity of 76 buildings in Providence, RI, with a goal of quantifying the "wetness" of buildings. This effort was part of a larger study involving lead remediation and other Healthy Homes treatments. Hourly values of temperature and humidity were recorded for units in the buildings, typically in the family room and bedroom. Sensors were also placed in basements of the buildings, and several buildings were equipped with outdoor sensors. The values reported here are for one five-month wintertime period for 15 buildings (31 dwelling units).

The approach in this paper is the moisture balance approach. Values of temperature and relative humidity were recorded for indoor and outdoor air. These values were used to compute the vapor pressure for both indoor and outdoor conditions. The difference between these two values is defined as the moisture balance. This analysis is predicated on the assumption that indoor vapor pressure in many living spaces closely tracks the outdoor vapor pressure, with a slight increment of indoor vapor pressure over outdoor. The increment is one characterization of indoor "wetness." This paper presents the moisture balance method and describes potential applications of the technique. There is also a discussion of the findings from the Providence homes, including: 1) relation between sensor location within a building and moisture balance value, 2) influence of the duration of the measurement period, 3) impact of the addition of ventilation fans, and 4) buffering effects.