24th AIVC conference
& BETEC Conference
Summing-up of the conference

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1. INTRODUCTION

This is a personal set of comments giving my impressions of the papers presented at the AIVC/BETEC conference, *Ventilation, Humidity Control, and Energy*, held in Washington DC 12-14 October 2003. The filters I use in describing particular papers represent my interests in the general topic area.

- I learn most from papers with an experimental content, preferably field studies of building performance. I believe that we in the building sciences fail to evaluate buildings after they are completed unless occupants are severely dissatisfied. This lack of evaluation limits change in the field and poor education of those who follow.
- I also am most interested in problems and issues of residential buildings.
- I approach this field as one who has spent most of his career studying buildings in the United States and therefore bring a U.S. perspective to the summary.
- A good part of my career has been spent working with issues of air pollution within buildings. A great concern of mine is the divide between building scientists and health scientists as indoor air quality issues are investigated.

2. HEALTH AND BUILDING SCIENCE

Dr. Suellen Pirages gave an excellent summary ["Mold and Health Issues" by Suellen W. Pirages] of observations of indoor and outdoor mold concentrations and health effects associated with mold exposures. There has been considerable publicity generated concerning mold exposures and health effects associated with these exposures. She described what is known about these health effects, i.e., that mold exposures causes allergic reactions in about five percent of the population and noted that epidemiology that demonstrates other health effects associated with mold is lacking. Clearly there are situations where very large exposures (to farmers in a dusty environment when harvesting, for example) or when exposures to an individual with a non-functioning immune system occur (a patient receiving an organ transplant in a hospital). These exposures can lead to severe problems, even death. Most individuals, however, are not a large risk from indoor exposures.

Prof. Hugo Hens ["Mold in Dwellings: Field Studies in a Moderate Climate" by Hugo S.L.C. Hens] described exploration of climate, living habits, and design and construction of 33 spaces that had been reported to have mold problems. A mold model that had been developed by his group at Leuven was applied to the spaces. In all cases the field observations were consistent with the factors deemed important in predicting the presence of mold. Major elements of the theory include indoor temperatures that are too low, insufficient ventilation and thermal bridging. These factors permitted explanation of mold conditions observed.

Prof. William Rose described revisiting a paper that is used to justify approval of unvented gas space heaters in 47 of the 50 states in the United States ["Model Replication to Challenge the Use of Unvented Combustion Heating Appliances" by William B. Rose, Paul W. Francisco and Chuang-Ming Liu]. Rose and colleagues were unable to obtain the model that was used to generate the results in the DeWerth (1996) report so recreated it themselves. Qualitative agreements with the DeWerth results were demonstrated. Rose and colleagues will extend the model to situations seen in typical US housing to test pollution concentration limits in these extended contexts. This is an important test of potentially significant indoor pollutant source.

3. BUILDING EVALUATION

Armin Rudd and colleagues describe a careful evaluation of 20 homes built in the hot, humid climate of Houston, Texas ["Residential Dehumidification and Ventilation Systems Research for Hot-humid Climates" by Armin F. Rudd, Joseph W. Lstiburek, and Kohta Ueno]. The authors describe a test involving six different options to control indoor humidity, provide ventilation, thermal comfort, and energy efficiency in these production homes. They found that a stand-alone dehumidifier in hall closet with central-fan-integrated supply ventilation and 33% central fan cycling was the preferred system in this difficult climate. This conclusion is based on measured humidity control, first cost and operating costs.

Dr. Willem de Gids describes measurement results in a statistically valid sample of housing found in The Netherlands ["Ventilation in Dutch houses - A Study in a Representative Sample of the Dutch Housing Stock" by W. de Gids]. These measurement results can be projected to the Dutch housing stock and form the basis for future policy initiatives. Paraphrasing the author the results demonstrate that ventilation in this housing stock is quite good; that better

ventilation performance requires educating occupants who control the ventilation; and high prevalence of respiratory diseases noted in the occupant surveys cannot be explained by ventilation results. Studies such as these should be undertaken in other countries, particularly in the United States.

Michael Lubliner and colleagues explore the performance of an important category of U.S. housing, manufactured homes ["Building Envelope, Duct Leakage and HVAC System Performance in HUD-Code Manufactured Homes" by Michael Lubliner, Andrew Gordon, Neil Moyer, William Richins, and James E. Blakeley]. These buildings, comprising about 20% of the U.S. market have been upgraded in programs developed by HUD and the EPA. The paper collects data about these homes and uses computer simulations to study the economic impact of the improvements. The authors demonstrate the cost effectiveness of the changes.

Also noted are the single-building studies of new manufactured homes reported in "Energy and Air Infiltration Monitoring of Manufactured Homes in Cold Dry Climates" by James E. Blakeley, William D. Richins, Thomas K. Larson and George A. Twitchell and "Ventilation Characterization of a New Manufactured House" by A. Persily, J. Crum, S. Nabinger & M. Lubliner. These studies provide a bridge to the topic of single-building studies.

4. SINGLE-BUILDING STUDIES

Other single-building studies of note are "Passive Cooling in a Low-Energy Office Building, Importance of Night Ventilation in Passive Cooling" by H. Breesch, A. Bossaer, and A. Janssens, and the forensic investigation, "An Evaluation of Natural Ventilation and Comfort of a Multi-Storey University Office Building" by Mark B. Luther and Benedict Dozie Ilozor.

Breesch et al. demonstrate that the major contributor to passive cooling in the low energy office building in Belgium that they studied was night ventilation rather than an earth-to-air heat exchanger. Luther and Ilozor investigated a recently-constructed passively ventilated building at Deakin University in Australia. The thermal comfort in the building was not acceptable to many occupants. The authors demonstrate design problems in the building that led to the poor thermal comfort. Recommendations for building modifications are provided.

5. EXPERIMENTATION

Blazy and colleagues describe changes they made in nine flats of a collective building in France to improve ventilation and humidity control ["Humidity Controlled System in French Collective Buildings Refurbishment" by M. Blazy, A.M. Bernard and F.R. Carrié]. Exhaust fans were installed in the kitchens and bathrooms of the flats; humidity-controlled inlets were installed in the bedrooms and living rooms. Energy use decreased while occupant satisfaction increased. This is one of a number of papers presented at the conference that demonstrated the effectiveness of these humidity-controlled ventilation systems that were developed in France.

The paper of Niachou and colleagues, "A First Study of Natural and Hybrid Ventilation Systems in the Urban Environment" by Aikaterini Niachou, Mat Santamouris and Iro Livada, describes a work in progress. Modeling and measurement issues associated with natural/hybrid ventilation application in difficult urban setting in Greece are described. Changes in pressure distributions with wind direction and location within the "urban canyon" of a densely occupied city street are presented.

6. BUILDING SCIENCE

Building science is a somewhat pretentious title for this section since all the papers at the conference belong to this general category. However the papers of Bomberg et al. "Weather Resistive Barriers: New Methodology for Their Evaluation" by M. Bomberg, M. Pazera, J. Zhang, T. Mungo and F. Haghighat, and Walker and Sherman's, "Heat Recovery in Building Envelopes" by Iain S. Walker and Max H. Sherman, seem to me to represent the best of what building science does -- identify a problem and work systematically toward a solution.

Bomberg and colleagues describe a new test procedure to evaluate weather resistive barriers -- barriers that shed water that penetrates building cladding, provide a drainage plane when defects occur, and control the flow of air through the building fabric.

Walker and Sherman report an extensive investigation of the impact of heat recovery in the building envelope on energy use in the infiltration process. The authors developed a theoretical model of the process, subjected the model to a CFD analysis to study it on a computer, set up a laboratory experiment to study it in a controlled environment, and finally

studied it using field data collected at the Alberta Home Heating Research Facility. They are now publishing the results. The authors conclude that infiltration heat recovery is not significant for typical wood frame houses with insulated cavities because little of the building envelope participates in infiltration heat recovery.

7. STRATEGIES

Each of the ventilation strategies described below describes a different set of approaches and solutions to improving ventilation performance in houses. Jardinier ["Humidity Sensitive System is 20 Years Old" by Laurent Jardinier] described advances made in France with humidity-controlled devices responding to large sources of an important pollutant (water vapor) and, to some extent, as an occupancy sensor.

Temple and Holton ["Energy Efficient Residential Ventilation Control" by Keith A. Temple and John K. Holton] describe the need to improve the control of ventilation systems in a U.S. setting and appear to be moving toward a control strategy for quasi-hybrid systems. This type of system has not begun to penetrate the U.S. residential ventilation market.

Raymer ["User “Friendly”, Residential Ventilation System Control Strategies and Effectiveness" by Paul H. Raymer] describes the successes and frustrations of attempting to do this in actual practice in the United States. Finally, Jacobs and de Gids ["Reshyvent - Demand Controlled Residential Hybrid Ventilation" by P. Jacobs and W.F. de Gids] describe and demonstrate an exciting combinations of pressure-independent constant-flow inlets, low fan power central exhaust, and CO_2 sensing occupancy detectors to assemble a practical hybrid ventilation system that is widely used in The Netherlands. As suggested by comments above, a U.S. market for these devices is waiting.

8. NEW DIRECTIONS

Finding strategies to provide thermal comfort in hot, humid climates where chillers are an expensive solution is a global problem. Kato and his co-workers ["Proposal for an Energy-efficient Cooling System for a Residential Building in Hanoi" by Shinsuke Kato, Doosam Song, and Ryozo Ooka] describe the use of passive ventilation schemes together with radiant cooling panels to provide improved thermal comfort in Hanoi. Field measurements of thermal conditions and CFD simulations of flow fields give credence to their designs.

A second paper in this category by Healy and colleagues ["Development of an Optical Fiber-based Moisture Sensor for Building Envelopes" by William Healy, Shufang Luo, Mishell Evans, Artur Sucheta, and Yongcheng Liu] describes a promising new technology for sensing surface moisture using optical fibers. Alas, the author indicated in his presentation that the development efforts have been abandoned. We encourage review and reconsideration of this decision.