Session IX-A: Energy Efficiency and Sustainability

Wednesday, December 8, 2004
10:30 a.m. to 12 noon
Grand Ballroom – Beach

Session Chair:

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10:30 a.m. to 10:40 a.m. Introduction
Krishnan Gowri

10:40 a.m. to 11:00 a.m. *"Application of Advanced Tools to Develop Energy Efficient Building Envelopes that are Durable"*
Achilles Karagiozis

11:00 a.m. to 11:20 a.m. *"Comparison of Steady-State and Dynamic Building Energy Simulation Programs"*
Jeroen Van der Veken

11:20 a.m. to 11:40 a.m. *"A Full Life-Cycle Environmental and Cost Evaluation of Commercial Wall Envelope Systems"*
Jamie Meil

11:40 a.m. to 12:00 p.m. *"Wood-Frame Buildings: Numerical Study of an Envelope with Ventilated Walls"*
Gilles Fraisse

Application of Advanced Tools to Develop Energy Efficient Building Envelopes that are Durable

Achilles Karagiozis – *Oak Ridge National Laboratory*

In the recent past, building envelope designers and architects relied heavily on tradition to define and prescribe exterior envelope components of a building. Workmanship and understanding of the local materials were key to the success of the building project. Today, designers and architect frequently are asked to design buildings that are highly energy efficient. Sometimes this results in unexpected problems, as almost all current design guidelines do not specifically address moisture control. Established approaches exist to reduce thermal bridges in building envelopes; however, few guidelines exist to reduce moisture bridges. Major changes in the thermal, and moisture performance properties of key material components are being introduced into the building market. Designers are therefore required to analyze the heat and moisture transport of the envelope systems for the implemented climate.

Recently several advanced hygrothermal models have been developed and are widely available to the general public to assist in the design of both the thermal and moisture performance of building envelopes. In this paper, the application of ORNL's state-of the art hygrothermal model, MOISTURE-EXPERT, will be demonstrated using three different ventilation strategies on a wall envelope system. A moisture engineering approach is used. Results are presented to demonstrate how one could apply hygrothermal modeling tools to assist in both design objectives—energy efficiency and durability. Experimental data will be presented to benchmark the model. Finally, the paper will present a preliminary analysis to show the sensitivity of the hygrothermal results of cavity ventilation envelope on different exterior environmental loads.

Comparison of Steady-State and Dynamic Building Energy Simulation Programs

Jeroen Van der Veken, Dirk Saelens, Griet Verbeeck, and Hugo Hens

Catholic University of Leuven

This paper presents the results of a comparison between EPW (Energie Prestatie Wetgeving, i.e., the new calculation method of the Flemish Energy Performance Regulation) and two transient building energy simulation programs: TRNSYS and ESP-r. The Energy Performance Regulation and the three calculation programs are described and their calculated net energy demands are compared to each other and to experimental data from a co-heating test. Considering the steady-state nature of the EPW model, the results of this research are very promising.

A Full Life-Cycle Environmental and Cost Evaluation of Commercial Wall Envelope Systems

Mark Lucuik – *Morrison Hershfield Limited*

Jamie Meil – *ATHENA Sustainable Materials Institute*

This paper compares and contrasts nine typical commercial wall systems, taking into consideration their respective material environmental life-cycle burdens, operating energy effects, direct construction and operating energy costs, and indirect costs, or what are known as social or externality costs.

Using commercially available environmental life-cycle assessment, operating energy, and direct construction cost databases and software tools, as well as public sources for fuel prices and externality costs of material and energy use-related emissions to air, water, and land, the full environmental life-cycle costs of each wall system was estimated over a 20-year time period as built in Toronto.

The paper describes life-cycle analysis and full-cost accounting, including environmental externality costs—the additional costs to society in terms of human health and environmental damage that are not incorporated into our present economic system. The integration of life-cycle assessment, life-cycle costing, and externality costs in one method solves the problem of having to intrinsically weigh direct costs against the array of environmental burdens as all results are expressed in monetary terms—a terminology that all decision makers understand and can appreciate.

This more robust decision-making framework offers us a method for moving away from what some would call our current subjective or prescriptive decision-making process, with its inherent pitfalls, to one that is more holistic, objective, and ultimately performance based.

Wood-Frame Buildings: Numerical Study of an Envelope with Ventilated Walls

Gilles Fraisse, Gilbert Achard, Valentin Trillat-Berdal, and Kevyn Johannes

University of Savoy, ESIGEC

The objective of the study is to compare energy performances of different kinds of ventilated facades in the case of wood -frame buildings. The existing air gaps within this kind of building are a technical and financial advantage (easier installation). The principle of the ventilated facades (opaque or translucent) is to preheat fresh air by making it circulate in one or two serial air gaps. It leads to recovering in winter a part of heat losses through the envelope and of solar radiation. With regard to a nonventilated facade, global heat losses (walls and ventilation) are lower. A numerical modeling allows one to compare the energy performances of various ventilated walls: one or two serial air gaps, composition of the wall (layers), and glazed wall (increasing solar heat recovery).