Session II-A: Air Leakage

Monday, December 6, 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
Bruce Wilcox

1:40 p.m. to 2:00 p.m. *"Air Transport in and through the Building Envelope"*
Claes Bankvall

2:00 p.m. to 2:20 p.m. *"Driving Rain, Rain Absorption, and Rainwater Runoff for Evaluating Water Leakage Risks in Building Envelopes"*
Jan Carmeliet

2:20 p.m. to 2:40 p.m. *"Indoor Temperature, Humidity, and Moisture Production in Lightweight Timber-Framed Detached Houses"*
Targo Kalamees

Air Transport in and through the Building Envelope

Claes Bankvall, Björn Mattsson, and Angela Sasic Kalagasidis

Chalmers University of Technology

A national R&D program dealing with air transport in and through the building envelope is presented, including some overviews of results. The program develops predictive models for evaluating air movements in and through the building envelope. These models are coupled to the outside climate and pressure situation and to the inside climate through the interaction with models defining the building services system. A major aim of the program is to analyze problems of relevance to the building process. This includes site inventory, modeling of typical situations, and laboratory testing for input data and to validate the models. The objective is to develop tools to help design and evaluate building elements and to give the necessary foundation for estimating the convective transport of heat and moisture in the envelope, which is decisive for the indoor climate, the consumption of energy, and the durability of the construction. The research program is ongoing and this presentation is to invite communication with others.

Driving Rain, Rain Absorption, and Rainwater Runoff for Evaluating Water Leakage Risks in Building Envelopes

Jan Carmeliet and Bert Blocken – *Catholic University of Leuven*

Driving rain is one of the major sources of moisture in building envelopes causing moisture damages. Depending on the capillary absorptivity, moisture storage of surface materials, and the rate of driving rain, a water film forms and runs down the wall, leading to an important accumulation of water and an increased risk for rain penetration and leakage. In this paper the driving rain distribution in time and space and the occurrence of runoff for different building typologies is analyzed: a tall and a long low-rise building, a building with an opening, and a tall building with an underpass. A computational fluid dynamics (CFD)-based model for driving rain is combined with a heat and moisture transport model for capillary active materials and a runoff model is added based on the thin film theory. Driving rain and runoff intensities are highest at corners and edges of the building, while a sheltered zone at the bottom of the building may exist. Runoff depends also on the moisture transport characteristics of the surface material. The use of semi-empirical relations based on driving rain coefficients for evaluating the driving rain intensity is critically analyzed. It is concluded that the driving rain coefficient should be handled with care, since it is found not to be a constant during time for a given place on the building facade.

Indoor Temperature, Humidity, and Moisture Production in Lightweight Timber-Framed Detached Houses

Targo Kalamees – *Tallinn Technical University*

Jarek Kurnitski – *Helsinki University of Technology*

Juha Vinha – *Tampere University of Technology*

This paper discusses a study that measured and analyzed the indoor climate conditions in 46 lightweight timber-framed detached houses occupied by single families. This survey was conducted during 2002-2003 in Finland. The main objectives were to analyze the indoor temperature and moisture conditions as well as to determine the internal moisture supply and moisture production. Additionally, the impact of HVAC systems and envelope solutions on the indoor climate were analyzed. The temperature and relative humidity were continuously measured in bedrooms, living rooms, and outdoors. The results showed high indoor temperatures during the summer period and rather unstable temperature conditions during winter, which exceeded acceptable comfort levels in most of the studied houses for a long period of time. During the summer, ventilation systems had significant influence on the indoor temperature levels, humidity levels, and the average daily amplitude of temperature and humidity. The vapor-permeable envelope caused low relative humidity in the winter, and the indoor air was drier for a longer period than in houses with a vapor-tight envelope. The hygroscopic mass showed effect on the average daily amplitude of humidity. Based on the measured indoor and outdoor humidity values, the moisture supply values were calculated. Using those calculated values along with measured air change rate, the moisture production rates are specified.