MOISTURE MANAGEMENT AND ENERGY ANALYSIS IN BUILDINGS

Prof. Hens[1] and Dr. Wahid Maref[2]

1. A FIELD MONITORING STUDY OF INTERSTITIAL CONDENSATION IN WOOD-FRAME WALLS IN COLD CLIMATE (Dr. Wahid Maref)

At NRC-IRC's new Field Exposure of Wall Facility (FEWF), experiments with three identical test specimens of traditional 38 x 140 mm (2x6) wood-frame wall construction were conducted in Fall 2006 and continued until spring 2007 to benchmark the facility and commission the data acquisition system. From Jan to April 2007, two of the three test specimens were subjected to different levels of indoor relative humidity and air leakage to examine the condensation potential in different layers of the wall assemblies and to yield valuable information on the systems' characteristics and performance. Testing was conducted with and without specific "deficiencies" (i.e., an opening) in the air/vapour barriers of two of the three specimens, to characterize the response of the walls to air leakage in terms of condensation potential and moisture content of moisture-sensitive materials. This research focuses on the hygrothermal response of the test specimens and gives highlights of experimental results and analysis for the first year of operation.

2. A FIELD MONITORING OF ENERGY-RETROFITTED WALL ASSEMBLY (Dr. Wahid Maref)

The scope of work included the design of the experiments, the installation of test specimens, the commissioning of the instrumentation, the operation of the test facility, the monitoring, data collection & analysis and reporting in a project conducted at NRC-IRC BES's *Field Exposure of Walls Facility*. The characteristics of residential retrofit strategies can have an impact on the energy performance and the durability of the exterior walls. In this research one retrofit strategy consisted of installing a low air and vapour permeance insulation board while the second strategy involves a high air and vapour permeance insulation. Each insulation material is added on the exterior of an existing R20 2X6 traditional construction test specimen. The two specimens have been challenged with high indoor relative humidity and air pressure while construction deficiencies providing a path for air leakage were introduced. Data has been collected to compare the hygrothermal response of the test specimens at critical locations within the test assembly, over the Fall, Winter and Spring 2008, and compared to a third test specimen which acted as a reference. This research is one of a series of projects that highlight direct and indirect impacts of hygrothermal performance of the building Envelope technologies in houses.

3. ASSESSMENT OF ENERGY RATING OF POLYURETHANE SPRAY FOAM WALLS: PROCEDURE AND INTERIM RESULTS (Dr. Wahid Maref)

The application of polyurethane spray foam (SPF) insulation in buildings provides a durable and efficient thermal barrier. The industry is also promoting the SPF as an effective air barrier system in addition to its thermal insulation characteristics. In an effort to address these issues, a consortium of SPF manufacturers and contractors, jointly with the National Research Council of Canada's Institute for Research in Construction, (NRC-IRC) conducted an extensive research project to assess the thermal and air leakage characteristics of SPF walls as well as glass fiber walls. The objective is to develop analytical and experimental procedures to determine the SPF wall energy rating (WER). The experimental part included an extensive testing program to determine the wall air leakage rate at different conditions (e.g., ΔP= 50, 75, 100 Pa) and their thermal resistance, R-value, at different temperature differences (e.g., ΔT= 40 and 55 K). An analytical procedure was also developed to calculate WER by combining the heat loss due to thermal transmission and that due to air leakage with the aim of arriving at WER. Six conventional 2" by 6" wood stud walls, 2.4 m by 2.4 m (nominal size) and (16" O.C) made of two glass fibre batts, and of four SPF (medium density foams) were tested (2 foams by supplier were tested and 4 in total). Some walls were constructed as "blank or reference walls" and others were built with penetrations to reflect common construction practices. The two fibre batts insulation was filling the whole cavity (6-inches) which is equivalent to a wall with R-20. For comparison purposes and to have an R-20 for the medium density SPF, the cavity was filled with 3-inches of SPF. The testing regime included: i- initial air leakage and thermal resistance; ii- the walls were conditioned in the Dynamic Wall Test Facility (DWTF) according to an established routine; iii- then all walls were re-tested for air leakage and thermal resistance. This paper presents the results of six walls included in this project. The focus of this presentation will be on presenting a brief summary of the project objective, testing protocol and the

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theoretical approach to determine the WER for the six walls. In addition, the test procedures and experimental results (air leakage and R-value), wall samples construction of a number of walls are presented.

4. THIRTY YEARS OF ACTION FOR ENERGY EFFICIENCY IN BUILDINGS: WHAT ARE THE RESULTS? (Prof. Hens)

In the autumn of 1973 a first energy crisis swept over the industrialized world. In 1979 a second followed. The first reactions in the West reflected panic, but soon a correcting policy emerged with rational use of energy as one of the corner stones. From the beginning, buildings got special attention. Their share in the annual national end energy consumption, in fact, was unexpectedly high, while less consumption of highly valued energy sources looked affordable without jeopardizing building usability. On the contrary, better was possible with less.

One could expect that three decennia later, the results of such policy should be visible in terms of less energy consumed in buildings. This is hardly the case. Many reasons explain that anomaly. The average principal, designer, builder and contractor were not interested in energy efficiency. Investment costs and not future annual costs were the main concern. Legislation was introduced without any enforcement policy. The housing and tertiary building stock still expands, with a clear prosperity-linked trend towards detached dwellings with low compactness and large floor area. Urban planning remains business as usual. And finally, policy makers forgot to consider rebound effects and the impact of lazy workmanship when predicting the efficiency of fabric and building services related measures, resulting in an overestimation of avoided energy use, while at the same time they underestimated the inertia of such large system as the existing building stock, given the low retrofit and substitution rate.

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