Session V-B: Walls—Heat/Air/Moisture

Tuesday, December 7, 2004
10:30 a.m. to 12 noon
Grand Ballroom - Palm

Session Chair:

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10:30 a.m. to 10:40 a.m. Introduction
Mark Lawton

10:40 a.m. to 11:00 a.m. *"Air Pressures on Buildings, Air Movement Within Buildings and Through Building Enclosures: Present and Recommended Control Strategies"*
Wagdy Anis

11:00 a.m. to 11:20 a.m. *"Rehabilitation of Concrete Walls Using Additional Thermal Insulation"*
Helmut Marquardt

11:20 a.m. to 11:40 a.m. *"Building Envelope and Failure Analysis: A Case Study of a Masonry Veneer Failure Due to Air Leakage"*
Steven Murray

11:40 a.m. to 12:00 p.m. *"The Basis for Developing Consensus Standards for Exterior Insulation Finish Systems (EIFS)—Encompassing Durability*
Kevin Day

Air Pressures on Buildings, Air Movement Within Buildings and Through Building Enclosures: Present and Recommended Control Strategies

Wagdy Anis – *Shepley Bulfinch Richardson and Abbott*

Air pressures on the building enclosure, including wind, stack effect, and HVAC fans act on the building enclosure causing infiltration and exfiltration, and depending on climate and composition of the enclosure assembly, the associated problems of loss of control over the HVAC system, poor indoor air quality due to pollution migration, condensation, premature deterioration, and adverse occupant health effects of bacterial growth and energy loss are documented results. The ways these forces work on the enclosure will be discussed as will strategies to control them. How are air-leaky buildings actually being built? The present state of requirements for infiltration control in codes and standards in Canada, Great Britain, and the U.S. is reviewed. The pioneer air barrier code in Massachusetts—its logic, language, implementation, and enforcement—is analyzed, and the educational and technical assistance programs implemented by the commonwealth, a model for introducing new technology, are explained. Proposed changes to ASHRAE Standard 90.1-2001 and recommendations for the future are presented.

Rehabilitation of Concrete Walls Using Additional Thermal Insulation

Helmut B.R. Marquardt – *University of Applied Sciences*

Exterior walls of concrete buildings frequently exhibit surface deterioration due to corroding reinforcement. The usual method of concrete repair of these walls is expensive, and the results may be less than perfect. Diffusion calculations demonstrate that it is possible to dry the exterior walls of concrete buildings in a Central European climate by attaching additional thermal insulation to the outside of these walls. Laboratory and field tests confirm that it is possible to actually arrest the rebar corrosion.

Calculations using the WUFI-IBP/ORNL hygrothermal computer model show that exterior walls of concrete buildings will dry by means of additional thermal insulation in some North American climates too. This method makes it possible to arrest the rebar corrosion without the usual concrete repair and, at the same time, save heating or cooling energy.

Building Envelope and Failure Analysis: A Case Study of a Masonry Veneer Failure Due to Air Leakage

Steven M. Murray – *Morrison Hershfield Limited*

In recent years, the culprit of defects to buildings has been quickly assumed to be inadequate materials used inappropriately. The quick diagnosis often leads to blaming a particular material or product, and until the problem is properly assessed, perceptions of the material design may be unduly scrutinized. Whether or not the properties of the material are cause for damage to the assembly, the immediate response should always be confirmed with further investigation.

In the assessment of a recent prominent gallery, it was suspected that a masonry material was suffering premature deterioration. The owner was inclined to believe the simplistic assessment of preliminary investigators that the problem was limited to the composition of a single building material. Investigation of the situation revealed that it was not the material but in fact the substandard construction of the building air barrier assembly that had led to the deterioration symptoms. After intrusive masonry openings were conducted and freeze-thaw testing of the existing cladding units was performed, it became clear that the major reconstruction and expansion of the building that had occurred a few years earlier was the source of the damage. This expansion of the facility had added considerably to the total envelope area and had resulted in numerous intersections between new and old envelope elements. Air barrier defects were found at the junction of nearly every envelope element. In particular, the junctions of new windows to new masonry elements were found to be a consistent location of air barrier defects.

These widespread air barrier defects, combined with an art gallery environment where the relative humidity was being maintained at 50% and a positive interior pressure, resulted in huge quantities of water being introduced into the interstitial spaces of the exterior cladding by condensation. This water absorbed into the masonry units, making the units prone to freeze-thaw damage. The degree of moisture exposure to the masonry units would have resulted in the failure of most common masonry cladding materials. The material structure of this particular block system, being manufactured to simulate limestone, has the abnormal property of spalling inward during the occurrence of freeze-thaw damage, hence the confusion when compared to traditional clay masonry veneers.

The operations staff for the building continued to increase the positive internal pressure in attempts to control the desired interior conditions during winter. The increased pressure further worsened the moisture load upon the envelope by introducing more condensation into the interstitial spaces of the exterior cladding and accelerating the masonry deterioration.

The case study presented here provides a perspective on several lessons learned from the investigation and repairs. A small element of the overall envelope resulted in complete replacement of a large percentage of the cladding and excessively high operating costs. The relative benefit of air barriers versus vapor barriers is explored. The role of constructability issues such as erection sequencing, trade delineation, and trade responsibility are examined in relation to the envelope defects and resulting damage. Alternative designs are compared to the base condition in relation to cost, constructability, trade responsibility, operating costs, envelope performance, and long-term maintenance. Simple cost benefit scenarios are presented.

Although the real problem was ultimately discovered, the material that the structure was composed of was deemed to be faulty before further investigation had been completed. In the litigious environment that surrounds the construction industry, hasty judgments can cause serious (and sometimes unnecessary) financial burdens. Empirical evidence and in-situ assessment are always required to confirm professional instincts and, in this case, a perceived freeze/thaw problem with manufactured architectural block was, in fact, damage caused by significant defects in the air barrier system.

The Basis for Developing Consensus Standards for Exterior Insulation Finish Systems (EIFS)—Encompassing Durability

Kevin C. Day – *DuRock Alfacing International Limited*

Standards that encompass durability for EIFS have not been a primary mandate for standard-writing bodies thus far in North America. Durability typically has not been incorporated into standards for building material components or systems, in particular, where a system would be tested and evaluated as part of a complete assembly.

Durability considerations for EIFS, insofar as (a) aesthetics and maintenance issues and (b) serviceability (on the basis for replacement), are being explored through the work of ULC-S716. However, in the development of these standards, the requirements for rainwater management on framed wall construction have set the precedent such that durability of the EIFS becomes secondary to the moisture management properties of the assembly.

ULC-S716 has determined that framed wall construction requires a moisture barrier for protection of moisture-sensitive substrates; hence, the durability of the EIFS becomes intrinsic with the substrate wall.