Session IV-B: Walls – Design Issues

Tuesday, December 7, 2004
8:30 a.m. to 10:00 a.m.
Grand Ballroom – Palm

Session Chair:

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8:30 a.m. to 8:40 a.m. Introduction
Martha VanGeem

8:40 a.m. to 9:00 a.m. *"Comparison of Two Structural Wall Assemblies Using ETMMS (Exterior Thermal and Moisture Management System) in Low-Income Applications"*
Marilou Cheple

9:00 a.m. to 9:20 a.m. *"Energy-Efficient Building Facades: Case Study Comparisons of External Screen-Wall Shading Systems"*
Maurya McClintock

9:20 a.m. to 9:40 a.m. *"Lessons to be Learned from Performance Failures of Framed Walls in High Rise-Buildings"*
Mark Lawton

9:40 a.m. to 10:00 a.m. *"Innovative Wall Selection Approach"*
Tony Stall

Comparison of Two Structural Wall Assemblies Using ETMMS (Exterior Thermal and Moisture Management System) in Low-Income Applications

Marilou Cheple and Patrick H. Huelman – *University of Minnesota*

Stephen R. Klossner – *Advanced Certified Thermography*

Thomas Schirber – *Amherst H. Wilder Foundation*

During 2004, two different wall assemblies using an exterior thermal and moisture management system (ETMMS) were used in the construction of two low-income projects in St. Paul, Minnesota. This paper discusses and compares the two types of wall assemblies, emphasizing the differences in construction methods and procedures. Comparisons include energy, moisture resistance, indoor air quality, constructability, and acceptance.

Energy-Efficient Building Facades: Case Study Comparisons of External Screen-Wall Shading Systems

Maurya McClintock and Pete Alspach – *Ove ARUP & Partners*

Historically, building façades were adapted to the demands of the local climate—small windows and thermally massive building materials in temperate climates, large openings and lightweight materials in tropical climates. With the invention of air conditioning, buildings no longer needed to respond to local conditions, rather, the envelope became a sealed barrier between highly variable external conditions and a highly controlled, unchanging, comfortable internal environment.

Our increasing concerns about environmental degradation and the sustainability of our way of life has led to desires to design buildings and urban communities that enhance occupants' health and comfort, reduce building operating costs, and conserve resources. One of the principal strategies to reducing building energy demands and providing comfortable interior environments is an efficient building envelope system.

This presentation will illustrate the integrated design of a number of different types of external screen-wall façade systems and the impact they can have on the overall building energy efficiency of the project when used and designed appropriately. This presentation will illustrate the analysis and design process used as well as the resulting façade systems and project by comparing the slightly different vented, screen-wall systems designed for four different projects, each located in a different U.S. climate and each with different internal use.

- The Seattle Justice Center—illustrates a mechanically controlled, externally vented, double-glazed skin façade system with operable blind shading located in the cavity. The project is complete and the façade system is currently being monitored to assess actual performance against predicted performance.
- 60 Oxford St. Harvard—represents a fixed, dense slatted external shade system set off an operable window system (but in addition, preliminary design analysis for an externally vented, double-glazed skin façade system with operable blind shading illustrates local climatic benefits/design constraints between the Seattle and Boston climates). This project is currently under construction with targeted completion of July 2004.
- UC San Diego Pharmaceutical Sciences—highlights a fixed, planar, open-jointed, fritted glass shade screen to exposed, west-facing windows. This project is targeted for design completion and start of construction in June 2004.
- LA CalTrans Headquarters—illustrates a close-coupled fixed, planar, open-jointed, integrated PV shade screen and natural ventilation system. This project is currently in design.

Lessons to be Learned from Performance Failures of Framed Walls in High-Rise Buildings

Mark Lawton – *Morrison Hershfield Limited*

The building science and construction communities are now well aware of the high incidence and magnitude of premature envelope failure, due to rainwater intrusion, of wood-framed buildings in the temperate coastal climates of North America's west coast. What has been less publicized is the prevalence and magnitude of problems with the wall assemblies used on high-rise and other noncombustible buildings. The types of assemblies proving to be most at risk are metal stud-framed wall assemblies with gypsum sheathing. Major repairs, including recladding, have been required on numerous buildings in the region with steel stud-framed walls under a variety of claddings, including cementious stucco, exterior insulation and finish systems (EIFS), metal claddings, and masonry veneer.

The ability to review, compare, and contrast damage to several buildings that have had their exterior cladding removed is an opportunity afforded to few construction professionals. This paper will use project photos and analysis to share the findings and insights gained from a number of such projects. The case studies will be used to discuss important lessons for the design professional, including modes of failure of materials and systems, sources of water into the wall assemblies, location of systemic and isolated damage, problematic details, apparent contributory and mitigating factors, recommended modification to design practice, and areas requiring further investigation.

Innovative Wall Selection Approach

Achilles N. Karagiozis – *Oak Ridge National Laboratory*

Tony Stall and Roland Serino – *Dryvit Systems, Inc.*

Architects and engineers have recently been introduced for the first time to some very powerful tools that simulate the hygrothermal performance of building envelopes. These tools have been extremely useful in capturing the response of the envelope to interior and exterior hygrothermal environmental loading.

The hygrothermal response of a wall is strongly dependent on the material sequencing of the wall structure, embedded sub-systems (wall-window interfaces), and the material thermal and moisture properties of each layer. However, some of these system characteristics, "real performance attributes," can only be captured in the field or in carefully performed laboratory investigations and are needed inputs to advanced models.

To a designer/architect who is required to select and design an envelope for thermal and moisture performance, this task can be overwhelming. Today's engineers and architects have not been trained sufficiently in the area of heat and mass transfer of building envelopes, in particular, building physics; however, they are often tasked with selecting envelopes that perform well. At the same time, certain constraints such as construction costs, projected maintenance costs, heat and cooling annual costs, and service life projection all enter the decision-making process. In this paper, an innovative approach is presented that allows the architect or engineer to select a wall cladding based on moisture engineering principles that have already undergone a series of laboratory-determined hygrothermal material property characterizations, whole wall drainage and drying testing, real environmental analysis, and advanced hygrothermal performance assessment. This paper will provide the foundation and rationale for the development of this next generation of wall design tools for architects and engineers using EIFS wall systems as their application.