Session X-B: Whole Buildings—Green

Wednesday, December 8, 2004
1:30 p.m. to 3:00 p.m.
Grand Ballroom – Palm

Session Chair:

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1:30 p.m. to 1:40 p.m. Introduction
Silvio Plescia

1:40 p.m. to 2:00 p.m. *"Green, Healthy, and Affordable Homes on Their Way to Zero Energy—A Case Study"*
Robb Aldrich

2:00 p.m. to 2:20 p.m. *"The Importance of Building Envelope Commissioning for Sustainable Structures"*
Paul Totten

2:20 p.m. to 2:40 p.m. *"Prefabrication and Sustainability in UK Housing"*
Mark Gorgolewski

Green, Healthy, and Affordable Homes on Their Way to Zero Energy—A Case Study

R. A. Aldrich and D. K. Owens – *Steven Winter Associates, Inc*.

In Chicago, IL, Claretian Associates, a nonprofit community development organization, and South Chicago Workforce, a local nonprofit contractor, began construction of the "New Homes for South Chicago III" development. This development, with significant support from the city of Chicago and the state of Illinois Department of Commerce and Economic Opportunity, takes great steps toward making city-sponsored housing healthy, efficient, and affordable to own and operate.

The homes are constructed of structural insulated panels (SIPs) yielding R-25 walls and R-42 roofs. The homes are heated with condensing furnaces and lit predominantly with compact fluorescent lamps. The homes are very airtight (blower door tests show near 400 CFM50 for all homes) and achieve HERS scores above 90. The first twelve homes include 1.2-kW photovoltaic systems. As part of the Department of Energy's Zero Energy Homes and Building America programs, Steven Winter Associates, Inc. (SWA) has been working with the builder, developer, and other partners to assess the performance of the homes and their energy systems. Of particular interest to the builder was the effectiveness of various ventilation systems. The first three homes each have a different ventilation system:

- House 1: Energy recovery ventilator (ERV)
- House 2: Supply ventilation (outside air ducted to return plenum)
- House 3: Exhaust ventilation (controlled bath exhaust fans)

To assess the energy implications of these systems, SWA is monitoring electric energy consumed as well as the flow rate, temperature, and humidity of exhausted, supplied, and tempered air in each home. To evaluate the effectiveness of the ventilation systems in delivering fresh air, SWA is monitoring temperature, humidity, and carbon dioxide concentrations at three points within each home and outside. Of particular interest to SWA in the overall evaluation was how these efficient homes approached the "zero energy" target. SWA is monitoring total electricity consumed in the homes, energy produced by the PV systems, and operation of the gas furnace and water heater.

Regarding ventilation as well as energy consumption, preliminary results show that actively distributing air is important for ensuring IEQ and distributing air using typical residential air-handling equipment consumes tremendous amounts of energy.

While these results are not groundbreaking, the implications for homes targeting zero energy are significant. Figure 1 shows average daily energy consumption and PV generation for the three homes. In the first home (ERV system with distribution by central air handler), the ventilation system consumes an average of 11 kWh/day. In the second home (supply ventilation distributed by air handler), the ventilation system consumes an average of 6.5 kWh/day. The solar electric systems, by contrast, produce an average of 3.5 kWh/day. In working in similar climates with other builders targeting "zero energy," SWA has recorded average electricity use of 8-12 kWh/day. Most of these homes share one notable feature: hydronic heating without a central air handler.

The results of the monitoring further demonstrate that, when targeting "zero energy," energy efficiency is the first and most critical step. This session will review these findings in more detail specifically focusing on how ventilation, heating and cooling distribution, lighting specification, and lighting design should be optimized before more expensive renewable energy systems are considered.

The Importance of Building Envelope Commissioning for Sustainable Structures

Daniel J. Lemieux and Paul E. Totten – *Wiss, Janney, Elstner Associates, Inc.*

In order to be rewarded for environmentally conscious design and construction, the United States Green Building Council's (USGBC) LEEDTM rating system (USGBC 2002) requires that all buildings and structures satisfy a required commissioning process that, in the words of the USGBC, is intended to "verify and ensure that fundamental building elements and systems are designed, installed, and calibrated to operate as intended." This concept, which arguably is nothing more than a broadly worded restatement of what we already know to be good design practice, has taken on added significance in the context of environmentally conscious, or "sustainable," design. This is particularly true with regard to the effects of uncontrolled rainwater penetration and moisture ingress at the building envelope. Proper selection, use, and integration of the materials, components, and systems that compose the building envelope are critical to the long-term durability and performance of any building or structure and, as such, should be fundamental to the mission of the USGBC and the commissioning process required to achieve a LEED rating.

This paper will expand upon our findings (Lemieux and Totten 2004) on one award-winning example of sustainable design in the United States to explore how a more formal LEED commissioning process for the building envelope could arguably have changed the outcome of this project. Specifically, we will briefly discuss how issues related to material selection, interface detailing, and construction combined on this project to adversely affect the durability and performance of the building envelope, followed by a proposal to enhance the LEED commissioning process to include a more formal building envelope commissioning program. As currently written, the LEED reference guides and rating system do not provide a structured outline for building envelope design and construction, an area of practice that, by some estimates, accounts for up to 80% of construction litigation in the U.S. each year (Lemieux and Driscoll 2004).

Prefabrication and Sustainability in UK Housing

M.T. Gorgolewski – *Ryerson University*

UK housing is undergoing change. There is a concern about site-based, mainly masonry methods of construction and their ability to meet increasingly demanding standards of performance and quality and the availability of suitably trained labor. Although site-based construction can be efficient and of high quality, there are inherent difficulties in management, quality control, and efficiency due to the number of unpredictable factors such as weather, management of subcontractors, and scheduling issues.

Moving more of the construction process from the building site, where in the UK efficiency is often low and management difficult, into the relative safety of factory conditions, where efficiency and control can be better managed, has the potential to lead to significant improvements in both the quality and speed of construction compared to traditional site-based construction. This can lead to significant sustainability improvements. The technical benefits may include increased speed of production, reduced levels of defects and waste, greater efficiency in the production process, and reduced impact on the environment. This can also lead to social benefits including improvements in health and safety, more stable employment, and investment in machinery and development of skills. Greater stability in the manufacturing process also generates potential economic benefits.

All of these contribute to the environmental, economic, and social impact of the industry. This paper considers the growing relevance of prefabrication to the UK housing industry and discusses the sustainability benefits that may result from a move towards more off-site fabrication.