

## University of Minnesota – 2008 Annual Report

### Overview

Much of the current University of Minnesota housing research is focused on building technology and environmental issues specific to the north central region of the United States. An informal network of approximately a dozen researchers from a wide range of disciplines are concerned with solving problems associated with the design, construction, renovation, and operation of buildings in cold climates. There are several new initiatives at the University to increase research efforts in the housing arena. The Affordable Housing Initiative, led by the Center for Sustainable Building Research, has moved to support the Minnesota Housing Finance Authority's Green Communities efforts. The newly formed Bioproducts and Biosystems Engineering department has proposed an "advanced building systems center" built around the existing Cold Climate Housing and Bioproducts Marketing and Management programs. The Institute for Renewable Energy and the Environment and the newly created university-wide Institute on the Environment have both announced support for programs focused on building efficiency. The University of Minnesota Extension has added a full-time Regional Extension Educator in Housing Technology and the Cold Climate Housing (CCH) program has created a position focused on affordable housing technologies. CCH continues to serve as a focal point for regional research, technology transfer, and outreach to the home building industry.

### Part 1: Current Activities in Research

Industry support has dropped significantly in 2008 due to the housing downturn. However, an industry funded project to evaluate various insulation and moisture management strategies for stucco and fiber cement board siding was conducted at the Cloquet Residential Research Facility this past year. Research activity at the Foundation Test Facility at Rosemount was limited. Testing and on-going monitoring continued at the Jackson Street Village to provide additional insights on structural performance, energy analysis, and indoor air quality of this innovative project. The CCH staff continues to be active with the state and home building industry on both mandatory and voluntary building standards. The primary issues of concern are moisture management, foundation insulation, and green building. Below are three highlighted research initiatives – both ongoing and new—for 2008.

#### **1. SEP/ETMMS (Structural Engineered Panel / Exterior Thermal and Moisture Management System)**

We refer to this as a "studless" building system. It is essentially a monocoque construction methodology using 1-1/8" OSB (or in some cases a laminated 2-ply system). The structural system is then wrapped completely by a robust, self-healing moisture membrane (controls both liquid and vapor) from bottom to top, including the roof system. This is covered by XPS foam (1 to 2 inches under the slab, 2 inches on the foundation, 3 inches on the walls, and 5 to 6 inches on the roof). Furring strips are used on the walls to carry the siding and sleepers are used on the roof to accommodate venting, sheathing, and roofing. These houses have had blower door readings of 209 to 380 cfm at 50 Pascals. Obviously, we also marry this aggressive envelope system with a carefully engineered, high efficiency HVAC system, including make-up air for exhaust devices. Our demonstration houses have been built with affordable housing groups. Additional product testing and hygrothermal evaluation is being supported by a cooperative agreement with the US Forest Products Laboratory.

**2. Advanced Energy Efficient Roof Systems (U.S. Department of Energy):** The University of Minnesota and its industry partners have collaborated to develop a panelized residential roof system. Conventional residential roof construction in the United States utilizes closely-spaced roof trusses which often leads to unconditioned attic space. Mechanical systems and ducts placed in the unconditioned attic increase energy consumption for heating and cooling. More recent construction techniques have moved the insulation to the space between the trusses at the roof plane. This creates a conditioned attic with the ducts placed within the insulated envelope, resulting in documented energy benefits. The building industry partners see insulating at the roof plane with conventional trusses as an interim solution with the added challenge of coordination between several skilled trades. Another alternative, the use of structural insulated panels (SIPs), requires an underlying support structure, and long-term durability questions arise in terms of moisture control and the structural

properties of the SIP foam. The project that emerged from these concerns was to create a next-generation roof system with manufactured panels that incorporate structure, insulation, and possibly interior and exterior finishes. Panels would require support only at the ends with no intermediate supporting structure and must demonstrate optimal energy performance by minimizing thermal bridges and creating airtight seals at all joints. The system would minimize the risk of moisture problems and be durable, with at least a 50-year life that would be applicable to a range of design styles, climates, and conditions. The system must be easy to erect in the field with minimal reliance on skilled labor with a focus on lowest possible cost.

### **3. A Systems-Guided, Performance-Based Approach to Single Family Rehab**

As communities try to improve their housing stock, especially the vacant and boarded foreclosed homes, there is a need for a holistic approach that can address both current deficiencies and the long-term desired outcomes of a healthier, more durable and efficient home for low-income buyers. We are developing a four part process that starts with good overall assessment of the house along with current performance metrics. Then using this baseline information and the outcome targets a customized plan can be developed. This will be followed by oversight and monitoring during the construction process. The last step will be to conduct final performance testing and commissioning. We are starting to identify rehab changes that can have systems interactions that might be problematic. The intent is to develop a best practices and performance-based approach to get the best possible performance while limiting potential callbacks and liabilities for agencies, developers, contractors, and future homeowner. In a nutshell, this project is trying to bring the "systems approach" – that has been successfully applied and adopted for new homes -- to bear on our current demands to significantly upgrade the efficiency, durability, and air quality of our existing homes.

#### **Part 2: Current Activities in Teaching**

The Residential Building Science and Technology degree program continues to attract new students. We are also developing a RBST minor to attract more students, particularly those from disciplines such as architecture, housing, civil engineering, and mechanical engineering. Also, programs in architecture, housing, and construction management have seen large increases in student enrollment over the past few years. A new Masters in Sustainable Design has been very successful. The University student community has been very active preparing for the 2009 Solar Decathlon in Washington, D.C.

#### **Part 3: Current Activities in Outreach**

Requests for outreach continue to be strong. While most requests for training are connected to green building initiatives, there is still strong interest in Best Practices for Moisture Control. The CCH and CSBR staffs continue to be involved in a variety of affordable housing technical assistance projects. CCH faculty remain highly engaged in national technology transfer activities including DOE Building America, USDA Healthy Air for America's Homes and a variety of conferences including EEBA, Affordable Comfort, Better Buildings; Better Business, and the Energy Design Conference. Bill Angell, Director of the Midwest Universities Radon Consortium, continues to offer a solid slate of radon measurement and mitigation courses, including a newly developed online course designed for builders on Radon Resistant New Construction.

#### **Major Plans for 2009**

We will continue to develop the new "advanced building systems research and resource center" design and research agenda within the new departmental and collegiate structure. We believe next year will be a good year for housing research activities, especially in the areas of energy improvements and moisture transport relating to durability and indoor air quality concerns. We look forward to rebuilding some of our capacity and strength in our interdisciplinary research and technology transfer efforts.

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