

Housing Research Institute  
Del E. Webb School of Construction  
Arizona State University

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## 2005 Annual Report

### A. Overview and Organization

The Housing Research Institute (HRI) was formed to provide a focal point for residential construction research within the Del E Webb School of Construction. It promotes research and development in the Arizona homebuilding industry, including fundamental and applied research, educational programs, and innovation in materials, processes, and quality. The objective of the Institute is to effect the construction of higher value homes at a lower cost: homes that are more energy efficient, durable, sustainable, and safer.

#### Personnel:

Dr. Howard Bashford, Co-Director  
Dr. Anil Sawhney, Co-Director  
John Gallagher, Affiliate Faculty  
Nick Zeniuk, Affiliate Faculty  
Jacqueline Thompson, Senior Research Associate  
Amanda Owens, Editor  
Jeff Crane, Research Assistant  
Josh Felt, Research Assistant  
Matthew Gehring, Research Assistant  
David Nevarez, Research Assistant  
Sivakumar Palaniappan, Research Assistant  
Pramod Tipparaju, Research Assistant

### B. Research Projects

Research is an invaluable part of HRI's program as HRI and AzPath work in conjunction to improve the quality, affordability, durability, and energy efficiency of new and existing homes. Through research we are able to study current trends, materials, practices, and processes used in homebuilding, analyze data collected through study, and thereby discover areas for improvement and create training programs and innovative methods that will aid the industry in effecting these improvements.

### **Benchmarking Current Practices**

Limited study data exists on the productivity of the homebuilding practices and processes. HRI is currently utilizing data mining techniques to establish a benchmark for the production time of typical single-family homes (cycle time). This data will allow the creation of simulation models enabling quantification of the financial benefits of alternative methods that reduce construction cycle time.

For example, in one study we are comparing the cycle time and number of man hours required to build model homes versus the cycle time and number of man hours it takes to build similar production homes, for which the cycle time can be up to two or three times as long. The study aims to identify wasted time during the production process, ultimately reducing construction cycle time for production homes.

In another study, through analyzing production and backlog data for the publicly traded home building companies, we aim to develop a predictive model for forecasting work in progress (WIP) as production, backlog, and construction cycle time change.

### **Implementation of Lean Thinking Concepts**

The completion of a specific subdivision requires numerous coordination points between independent contractors, which inevitably reduces the efficiency of the construction processes. Under current production management strategies, residential trade contractor workflow is extremely variable. One of our projects investigates the implications of even flow production control techniques to reduce workflow variability in an effort to achieve greater efficiency and productivity during construction.

### **Application of Supply Chain Management Principles to Develop Strategic Purchasing Decisions**

In this project, we are conducting research that would enable implementation of supply chain management in the construction industry. The objective of this is to align the goals of all those involved in order to arrive at a competitive and efficient supply network. This research uses simulation software as an analytical tool to evaluate the costs and profits of material and labor supply chains between the homebuilder and the framing subcontractor. One preliminary result of this work is that simulation results demonstrate that current lumber pricing strategies between homebuilders and suppliers result in a higher risk for the homebuilder.

### **ABC<sup>3</sup>- Arizona's Building Code Compliance Coalition**

In Arizona's Building Code Compliance Coalition (ABC<sup>3</sup>), building officials and builders work together to address issues relating to code compliance. Building code compliance is required in homebuilding, and early results indicate that many homebuilder quality control programs and code compliance efforts are not aligned. A major goal of this coalition is to gather data about code compliance difficulties and devise ways to integrate the efforts of home builders and trade contractors to assure code compliance.

### **Pervasive Production Space: An Innovative Information Technology Framework for Homebuilding**

Many entities with interest in the homebuilding industry, including government, industry, and academia, have advanced the hypothesis that information technology is an important means of improving performance in the industry. Cutting-edge computer technology is being utilized to measure performance changes and costs in the construction portion of the homebuilding business, leading to realistic measurements of how technology impacts the construction of new homes. Many of the roadblocks to providing housing for Americans are being overcome as rapid advances in technology in the areas of financing, management, design, materials, and supply chain management are employed. However, the craft-based construction portion of the homebuilding business has not been privy to this wave of new technology. The proposed research will broadly focus upon the development and identification of pervasive computing paradigms, methodologies, design tools, and technologies for delivery of critical information to the various stakeholders that participate in the homebuilding process and the measurement of changes in key performance metrics that occur in response. One of the interesting projects in this area involves the use of technology to increase building code compliance ratios.

### **International Cooperative Research: Investigation of Lightweight Materials and Constructability Techniques in Cost-Effective Housing in India and the USA**

The housing industry is a vitally important economic engine and satisfies the basic human need for shelter, both in India and the United States. Despite differences in economic stature, the need for safe, durable, and affordable housing in both countries is acute. The proposed research will combine the talent and ideas of researchers from Arizona State University (ASU), San Diego State University (SDSU), and the Indian Institute of Technology Madras (IITM) to complete a detailed review of the potential for autoclaved aerated concrete (AAC) and other similar materials, which will become a major component of the production housing industry in India and the US. The energy and thermal mass properties, durability, and cost effectiveness of AAC seem to have potential advantages over the traditional methods used in both countries. In this research, consideration of AAC research previously conducted at each of the universities involved will be expanded by discussion and integration with the work done at the other universities. An important added potential is the prospect that this research could lead to the identification of housing technologies that can be exported across international boundaries.

## **C. Educational Outreach**

### **Residential Construction Management Certificate Program**

The Residential Construction Management Certificate Program is designed to meet the needs of the industry in a time of immense growth. The program includes 40 hours of non-credit classroom educational activities for working professionals: it introduces the essential core topics of residential construction management, exposes students to emerging technologies and practices, and presents practical application of construction management principles. Seminar instructors include faculty from the Del E Webb School

of Construction at Arizona State University and construction leaders currently working in the construction management field.

### **Lateral Bracing Seminar**

The Lateral Bracing Seminar, first held in November 2005, was designed to introduce and explain the prescriptive method of lateral bracing as detailed in the 2003 International Residential Code (IRC). Along with reviewing the prescriptive code requirements for lateral bracing, the seminar focuses on the requirements for the Phoenix area and presents a decision tree developed to help the designer wade through the confusing language of the IRC. The information provided in this seminar is aimed at assisting those building designers, architects, engineers, building officials, building inspectors, home builders, framing contractors, and others who are interested in implementing this method of lateral bracing.

### **Safety Certificate Program**

In April 2006, HRI is planning a week-long series of classes to review safety requirements in the residential housing industry. These sessions are designed to stress adherence to these requirements in order to cut down on jobsite accidents and prevent injury.

## **D. Publications and Conferences**

Bashford, Howard, A. Sawhney, S. Palaniappan, and J. Thompson. **A Discrete Event Simulation Model to Analyze the Residential Inspection Process.** ASCE Computing in Civil Engineering Conference. Cancun, Mexico. July 2005.

Walsh, Kenneth D., A. Sawhney, and H. Bashford. **Production Models for Construction.** ASCE Journal of Construction Engineering and Management. (In Process).

Bashford, Howard, C. Fiori, J. Thompson, and J. Wilson. **The Effect of Pre-assembly on Musculoskeletal Disorders of Framers.** *International Journal of Industrial Ergonomics.* (In Process).

Bashford, Howard, A. Sawhney, J. Thompson, and M. Gehring. **The Impact of Residential Construction Inspection Failures on Municipalities.** Associated Schools of Construction Conference. Fort Collins, CO. (In Process).

## **E. NAHB Student Chapter**

The NAHB Student Chapter successfully recruited approximately 30 members this semester. In addition, they raised all of the money needed to send 16 people to the IBS show in Orlando, Florida. They have put over 300 hours cumulative work into the project thus far, and the 16 student members attending the IBS have also each completed 24

hours of community service for organizations such as the Tubular Sclerosis Organization and the Special Olympics.

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