

Panel 1 Introduction

Residential Buildings: Technologies, Design, and Performance Analysis

Energy efficiency in residential buildings from integrated design to appliance standby losses is the subject of this panel. This is mostly a “nuts and bolts” set of papers, presenting the latest work on ducts, infiltration, heat pumps, water heating, and controls. Field measurements of the performance of real buildings form the basis of most papers. For a broader perspective we also present papers on housing in Europe and the Middle East.

Integrated Building Design

Hoeschele and Springer describe the analysis methodology, performance, and cost-effectiveness evaluations for a new house constructed in the Coachella Valley desert region of Southern California. Elberling and Bourne examine three packages of energy efficiency measures that reduce the size or eliminate the need for mechanical cooling in a climate with 105° design temperature. Titus describes an innovative pilot program designed to optimize the energy performance of existing single family houses that had been previously retrofitted with conventional energy efficiency measures.

Systems

Reed et al. describe the effects of direct control of air conditioners on indoor temperatures for 200 households in Michigan. Akbari, Morsy, and Al-Baharna present a cost/benefit analysis of energy-efficient technologies applicable to residential systems in Bahrain.

Ducts

Strunk et al. report that basement duct retrofits in 19 houses in New York and Wisconsin saved 9 percent of heating energy. Palmiter and Francisco present a practical method for estimating the thermal efficiency of residential forced-air distribution systems. Andrews compares the proposed ASHRAE duct efficiency calculation to field measurements. Jump, Walker, and Modera show that duct retrofits in 24 houses in Sacramento saved an average of 18 percent of HVAC energy use. Walker et al. report that duct retrofits on 5 New York apartments saved 10 percent of heating energy use. Modera, Dickerhoff, and Nilssen report that their aerosol-based technology sealed 80 percent of the duct leaks in 47 Florida houses.

Ducts in Manufactured Housing

Davis, Siegel, and Palmiter report that manufactured homes built to an adaptation of the Pacific Northwest Model Conservation Standards had a better duct efficiency than typical site-built homes, but still lost 20 percent of their heating energy to the ducts. Conlin reports that 24 new HUD-code manufactured homes in four regions of the United States had an average duct system efficiency of 55 percent in heating and a delivery efficiency of 81 percent in cooling.

Building Envelope

Brandis et al. found that triple-glazed glass windows were not a cost-effective retrofit option based on field tests in 98 Pacific Northwest homes. Akbari, Levinson, and Berdahl present a draft ASTM standard for measuring, rating, and labeling the solar properties of roof materials. Hageman and Modera report on a field test of the energy and peak load savings of a roof radiant barrier system on one house in Texas.

Ventilation

Armstrong et al. reports on measurements and analysis of infiltration and ventilation in Russian multifamily buildings. Feustel and Diamond use diagnostic tests of air flow and air leakage to characterize some common ventilation problems in high-rise apartment buildings and suggest strategies to improve the performance of these systems. Francisco and Palmiter report on detailed infiltration measurements on 10 homes from a series of studies designed to improve infiltration models.

Residential Appliances

Wong and Leber examine the life cycle cost of owning and operating residential water heating systems based on the source of heat: electric resistance heating, natural gas, solar with electric backup, solar with gas backup, and electric heat pumps. Yamagami, Nakamura, and Meier describe the details of a new non-intrusive gas metering system for residential appliances. Drost and Wegeng summarize recent research on miniature and microscale heat pump systems. Springer and Rohe provide results from field tests of swimming pool pump motor retrofits and the use of photovoltaic-powered DC pumps for pool filtration. Rainer, Greenberg, and Meier describe strategies to reduce “leaking” electricity by appliances, based on observations of whole-house energy consumption as well as direct measurements of each appliance in a house.

Rosenquist describes the use of common technologies such as high-efficiency rotary compressors, grooved refrigerant tubing, slit-type fins, subcoolers, and permanent split capacitor fan motors to achieve 10.0 EER efficiency levels for room air conditioners. Hughes and Shonder report that geothermal heat pumps appear to pay for themselves with energy, demand, and maintenance savings when implemented in mega-projects, such as the conversion of 4,000 military housing units at Fort Polk, Louisiana. Lambert describes a field test of electronic line voltage thermostats and analyzes their ability to save energy and maintain occupant comfort at lower temperature setpoints than bimetallic thermostats.

Betsy Krieg
Pacific Gas & Electric Company

Bruce Wilcox
Berkeley Solar Group