Building America Case Study

High-Performance Walls in Hot-Dry Climates

PROJECT INFORMATION

Project Name: High-Performance Walls

Partners:

Alliance for Residential Building Innovation,
arbi.davisenergy.com

Pacific Gas & Electric Company,
pge.com

Building Component: Envelope

Application: New; single and/or multifamily

Year Tested: 2013–2014

Applicable Climate Zone: Hot-dry

PERFORMANCE

Incremental cost of energy efficiency measure (including labor): from $0.13–$1.16/ft² for single-stud wall options, –$3/ft² for double-stud

Projected energy savings: 11%–19% annual HVAC source energy savings for the climates evaluated

Projected energy cost savings: $68–$130 annual utility cost savings (varies with utility rates and climate)

Building AMERICA U.S. Department of Energy

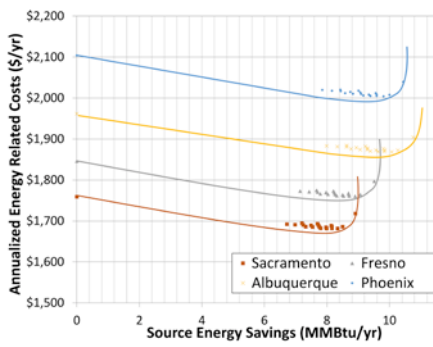
High-performance exterior walls are key to a durable and efficient building envelope and form the cornerstone of zero energy ready homes. Equally important as the benefits of improved wall thermal performance are the synergistic whole-house effects that influence heating, ventilating, and air-conditioning (HVAC) design and sizing. As mechanical contractors gain a higher level of confidence in envelope integrity, high-performance walls will facilitate the HVAC industry's use of smaller, compact duct designs that are fully integrated into the conditioned space.

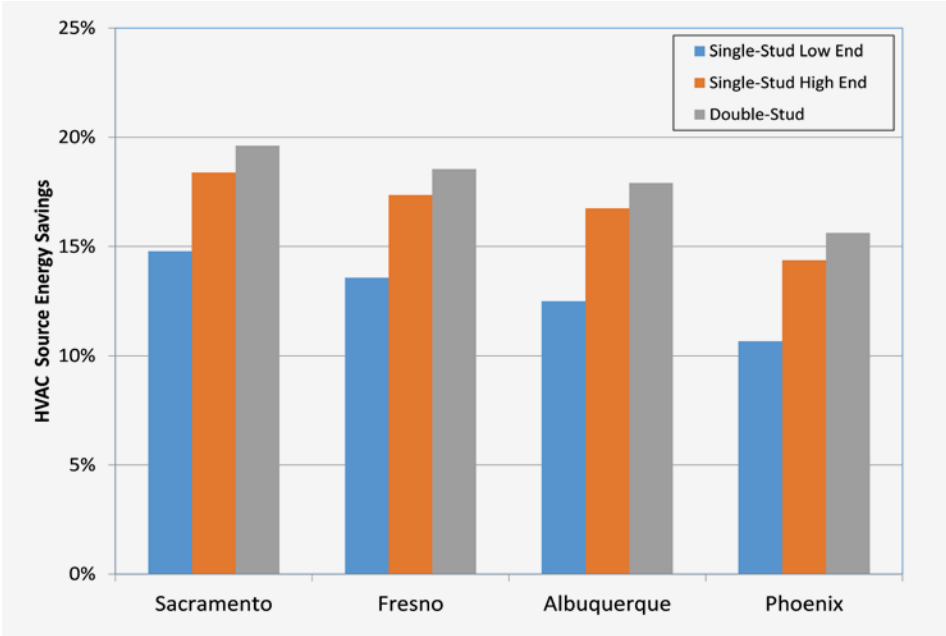
The U.S. Department of Energy's Building America team, Alliance for Residential Building Innovation (ARBI), worked with project partner Pacific Gas & Electric to secure participation from a number of builders in northern California to implement wall assemblies meeting a U-value lower than 0.050 Btu/h-ft²-°F. ARBI and its project team members helped builders identify preferred wall designs that met the requirements of their architects, structural engineers, and purchasing agents and that were acceptable to their subcontractors. Construction methods were observed and documented. Construction costs obtained from builders were used to inform cost estimates for a range of advanced wall system types and insulation types. Wall framing types of 2×6 (16- and 24-in. on center [o.c.]) and double stud were modeled in Building Energy Optimization (BEopt™) software with cavity insulation levels ranging from R-19 to R-33 (double stud) and exterior rigid insulation of R-4, R-6, and R-8.

BEopt simulations showed that all wall system cases were cost-effective relative to the 2009 International Energy Conservation Code benchmark wall (2×4, 16-in. o.c. with R-13 cavity insulation and no exterior insulation). The more costly double-stud wall generated a less favorable annualized cost than the single-stud options. Cost-effectiveness is expected to improve in cold climates. As shown in the graph on page 2, HVAC source energy savings of 11%–18% are projected for 2×6 wall types for the cases evaluated (stud spacing, insulation types, and exterior insulation impact the savings range); double-stud wall savings were 16%–19% in the climates modeled.

Results

Costs for each advanced wall system were built up from component costs. These included input from the National Renewable Energy Laboratory's National Residential Efficiency Measures Database, builder information collected in this project, and input from Title 24 energy code proceedings underway in California for the 2016 code revision. The graph shows the least-cost curves for the four climate regions modeled.





HVAC source energy savings of 11%–18% are projected for 2×6 wall types.

Lessons Learned

- All of the advanced wall assembly configurations were cost-effective. Consequently, builders have multiple options and flexibility in selecting wall designs that suit their situations.
- Only one of ARBI's builder partners had a framing contractor willing to build with 24-in. o.c. framing. Costs were kept low by having the framing contractor bid on a large number of homes.
- Builder feedback indicates that applying exterior foam thicker than 1 in. is currently a challenge. Window frames are not designed to handle 2 in. of foam, which complicates construction details.

Looking Ahead

Builders in California and other parts of the country with lower heating loads are beginning to explore advanced wall systems that achieve overall U-values of 0.050 Btu/h-ft^2-°F or lower. The 2016 Title 24 energy code is moving toward adopting this as a prescriptive standard for meeting the California 2020 zero energy goal. Transforming the market begins with education and training of key subcontractors. Case studies of successful implementation strategies will help to promote the efforts of early adopters to a wider audience. As framers, insulators, and drywall contractors gain familiarity with the key concepts, implementation challenges will be reduced and coordination between subcontractors will improve. The industry will innovate as it explores and optimizes strategies that meet its building designs, climate constraints, and marketing strategies and as new insulation products are introduced. In the near term, the California Advanced Homes Program will provide builder incentives for high-performance walls.

For more Information, see the Building America technical report, *High-Performance Walls in Hot-Dry Climates,* at *buildingamerica.gov*.

Image credit: All images were created by the ARBI team.

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DOE/GO-102015-4588 • April 2015