Building America Case Study

Technology Solutions for New and Existing Homes

Stud Walls With Continuous Exterior Insulation for Factory Built Housing

New York, New York

PROJECT INFORMATION

Project Name: Advanced Envelope Research for Factory Built Housing

Location: New York, NY

Partners: Manufactured and modular home building companies

The Levy Partnership, Inc., *www.levypartnership.com*

SBRA, *www.research-alliance.org*

AFM Corp., *www.afmcorporation.com*

BASF, *www.basf.com*

Dow Corp., *www.dow.com*

Johns Manville, *www.jm.com*

Owens Corning, *www.owenscorning.com*

CertainTeed, *www.certainteed.com*

Building Component: Walls

Application: New manufactured and modular homes

Year Tested: 2013

Applicable Climate Zone(s): IECC climate zones 5, 6, 7, and 8

PERFORMANCE DATA

Cost of Energy Efficiency Measure (insulation only): $1.42/ft^2 (R-5), $2.07/ft^2. (R-10)

Projected Energy Savings: 18% heating and cooling savings

Projected Energy Cost Savings: $180/yr

Building AMERICA SM U.S. Department of Energy

The Advanced Envelope Research project seeks to improve the energy performance of new factory built homes, a segment of the housing industry that accounts for about 12%–14% of the nation's total annual new home sales. The U.S. Department of Energy Building America team ARIES Collaborative conducted this research to develop the next generation of wall designs for the manufactured and modular housing industries. The solutions are shaped by three overarching qualities: minimal cost impact, ability to be seamlessly integrated into factory production, and substantial reductions in energy use.

The effort focuses on wood frame walls with continuous exterior insulative sheathing. In a twist to the traditional research model, the industry partners collaborated on a set of performance specifications for the wall. They challenged leading insulation manufacturers to develop solutions that conformed to the criteria but incorporated their proprietary products. The insulation companies proposed complete wall solutions that used either off-the-shelf or newly developed products, and worked closely with the ARIES technical team to refine their concepts. The process yielded more than 50 candidate wall designs that the industry partners vetted and evaluated.

> *"The collective design process is getting us to high performance wall solutions that we probably would never have reached as individual companies acting alone. We have had a shared vision of what we need to accomplish; we now have a way forward."*
>
> – Michael Wade, Cavalier Homes Director Manufacturing Operations

Five particularly responsive designs were ultimately selected for continued development. Next steps included two types of physical assessments. Structural tests (based on ASTM E564) were conducted to determine, on a preliminary level, if the designs developed sufficient shear strength for code compliance with U.S. Housing and Urban Development and International Residential Code. Concurrently, sample wall sections were mocked up to simulate the factory building process. This provided an initial impression of the issues to be resolved in integrating the designs into this process.

STUD WALLS WITH STYROFOAM

The use of Dow Styrofoam brand XPS insulation board and related products is a fairly well-resolved solution offering ease of construction, minimal thermal bridging, and air and weather resistive features.

Because the foam is high density, fairly simple window and door framing details can be used. Easily installed plastic sill flashing is an added benefit.

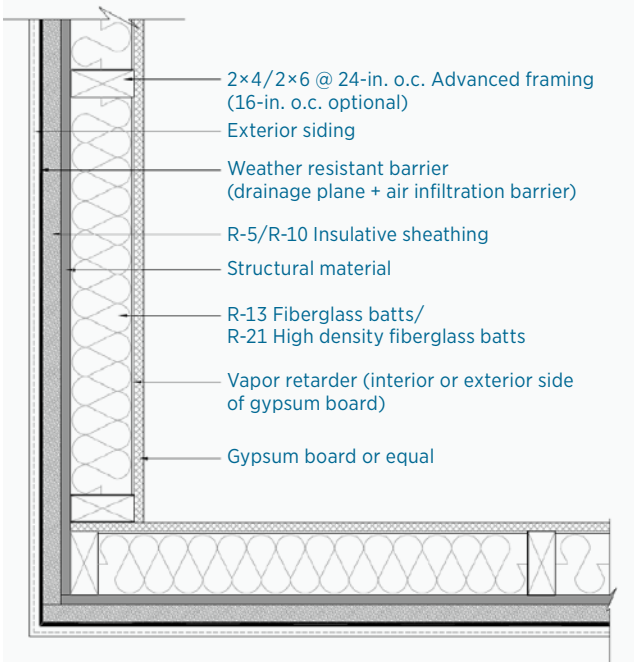
STUD WALLS WITH FOAM-CONTROL NAILBRACE

AFM's proposed advanced wall design is based on Foam-Control Nailbrace with integrated structural sheathing and weather-resistant barrier. It also incorporates a let-in strip to fasten the siding.

This solution has significant drawbacks: it is quite heavy, inflexible, and has furring location and fastening issues. These are formidable hurdles for factory builders.

For more information, see the Building America report, *Advanced Envelope Research for Factory Built Housing, Phase 3 — Design Development and Prototyping,* at *www.buildingamerica.gov*

Photos & Illustration from the ARIES team.



The figure to the left shows a typical wall section of a stud wall with exterior insulation. The design is intended to conform to the thermal requirements of the 2012 IECC for climate zones 5 (R-13+5), 6, 7, and 8 (R-13+10 or R-21+5).

Lessons Learned

The observations and conclusions from this effort include:

- If original equipment manufacturers can deliver a single product that can perform multiple functions (weather barrier, air barrier, structural capacity, etc.), home manufacturers will be able to eliminate production steps and thus reduce production costs.
- In the factory building environment where production speed is important for profitability, seemingly small considerations, such as required fasteners, weight (i.e., transportability) of materials, and simplicity of detailing become paramount.
- Exterior foam insulation presents technical issues, some of which are being addressed by others in parallel with this work. For example, the window industry and others are investigating the durability of windows that bear on the insulation. The results of those studies will benefit this research and help the larger building community.

Looking Ahead

The next phase of this research effort will complete the testing of wall designs that feature exterior foam insulation. The work will identify designs with the greatest market potential, and begin to clear the code, production, and design hurdles to commercial use.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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www.buildingamerica.gov

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