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.

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.

“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
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.