




TOOLBASESM FieldRESULTS



MADE Home Project: Bowie, MD

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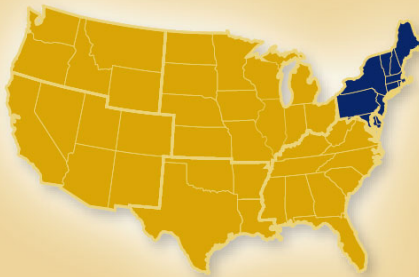
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RESULTS @ A GLANCE**LOCATION**

Bowie, Maryland

CLIMATE ZONE

Moderate

BUILDER

NAHB Research Center

SUBDIVISION

N/A

CONTRIBUTORS

- LD Holmes Architects
- National Housing Endowment
- NAHB Research Center
- PATH/U.S. Department of Housing and Urban Development
- Numerous product manufacturers

START DATE / COMPLETION DATE

July 2000 / March 2003

OBJECTIVES

1. To demonstrate the construction of attractive, marketable, entry-level homes that are affordable to build and operate.
2. Study the ability of fiber cement siding to manage moisture installed without the use of caulk.

TECHNOLOGIES EVALUATED

- Precast Concrete Foundation
- Ducts in Conditioned Space
- Air Admittance Valves
- Fiber Cement Siding
- Tankless Water Heater
- Stamped Concrete Exterior Walkways
- Split-face Concrete Block
- High Efficiency Refrigerator
- Structured Wiring
- Concrete Floor Finishes
- Advanced Framing Techniques
- New Generation OSB Sub-Flooring
- Recycled Wood/Plastic Composite Lumber

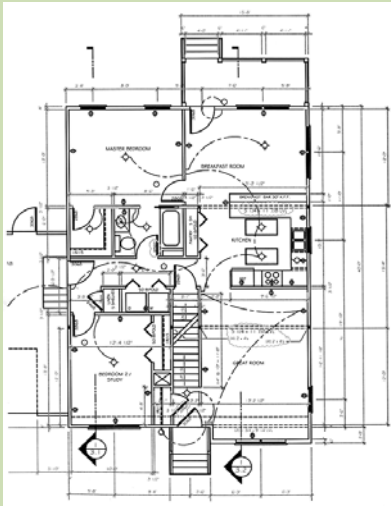
GENERAL CONSTRUCTION INFORMATION

1,850 square foot, single-family detached home on 30' x 40' footprint; 2x4 wood-framed walls using advanced framing techniques; low-E, single-hung vinyl windows; precast concrete panel basement; asphalt shingle roof; heat pump heating and cooling with ducts in conditioned spaces

SIGNIFICANT RESULTS

- For the fiber cement siding installed without caulk, there was no evidence of moisture intrusion past the building envelope over one year's time.
- Homeowners and builders were also surveyed about features of the home, and many would consider using the technologies in their own homes.





HOUSE DESIGN

The project consisted of four MADE (Marketable, Affordable, Durable, Entry-level) single-family detached homes, each under 2,000 sq. ft., located in the NAHB National Research Home Park in Bowie, MD. In-ground basements were made of precast concrete panels or decorative split-faced block. Wall frames consisted of 2x4 studs with R-13 fiberglass, R-30 blown cellulose attic insulation and were air sealed for optimum interior comfort and thermal performance. Open web floor joist framing allowed mechanicals to be located within the conditioned space of the building envelope and energy-efficient heat pump equipment was specified. Fiber cement siding and roofs covering entries provided durable features and architectural appeal. Composite architectural shingles or standing seam metal roofs with deep overhangs covered the homes. Two homes include OVE-framed roof rafters and two homes utilized roof truss systems with integral girders. The systems were compared for cost and installation time. Walkways adjacent to a community footpath used pigmented concrete.

HOW WE DID IT – A summary of the research methodology.

The Marketable, Affordable, Durable, Entry-level (MADE) homes were planned and designed using the concepts from the publication, *A Builder's Guide to Marketable, Affordable Durable, Entry-Level Homes to Last*. The efficient floor plans have a simple footprint, and features that are designed to be affordable for the life of the home. Energy efficiency and durability were emphasized.

Technology Implementation

Since the project was planned to demonstrate the use of a wide variety of advanced building technologies, most of the information collected was qualitative, rather than quantitative. Throughout the process of design, permitting, construction, and occupancy, NAHB Research Center staff participated in and monitored the implementation of the various technologies. In addition to monitoring costs, the team noted barriers to the use of the advanced technologies including performance, scheduling, interaction with other technologies, codes, and homeowner perception. This information was carefully collected and logged on the project website and the final report for the various systems of the homes.

A diverse group of over 30 builders was given a tour of the MADE homes. During the tour, concepts and technologies were pointed out and discussed. Builders were then given a short survey to gauge their current practices and the likelihood of using the concepts and technologies demonstrated in the MADE homes.

Fiber Cement Siding

The siding was installed with 2-inch galvanized roofing nails. Where face nailing was required on fascia and soffits, 8d spiral shank nails were used. Data collection focused on the area between the exterior cladding and the weather resistant barrier (WRB) and on the interior of the wall sheathing. Twenty-two pairs of moisture probes were installed around the test window to detect moisture migration through the sheathing. Six leaf wetness sensors were applied to the outside surface to determine if liquid water was present behind the cladding. The sensors were located between the fiber cement siding and the WRB.

Data were recorded in 15-minute intervals over a 12-month period between March 2002 and March 2003. In order to correlate the wall data with outdoor conditions, a weather station was also installed and monitored.



RESULTS

Technology Implementation Results

Precast Concrete Foundation:

- Local codes required the application of waterproofing, even though the high-strength concrete is naturally water resistant and does not require additional waterproofing.
- Preparing the gravel footing for the walls took about two hours for each site.
- Setting the basement walls took one hour per house with a crew of five, including the crane operator; total installation time was three hours per house.
- The first floor decking is framed before backfilling to provide structural support against the soil pressure.

New Generation OSB Subflooring:

- Despite two episodes of rain before the floor was under roof, the OSB subfloor experienced no edge swelling. The OSB and truss system provided squeak-free floors without the use of screws for fastening.

Air Admittance Valves:

- Although the technology is widely accepted in the codes, the local authority did not initially approve AAVs. However, a waiver was granted for their use ultimately.
- A plumbing riser diagram, prepared by the manufacturer, simplified the use of the technology by the plumber.
- One, 2-inch vent was required to the outdoors.

Electric Tankless Water Heater:

- Plumbing hook up was very similar to a conventional water heater.
- Hot water flow to tubs may need to be partially constrained in order for the water heater to meet hot water demand during the high flow rate used during tub filling.
- Required 120 amps and, therefore, a 300-amp service panel.

Structured Wiring:

- Low-voltage wiring for security system and structured wiring (CAT5) took a half day per house to install (see *Dollars & Sense* table on page 4 for cost information).

Fiber Cement Siding

- Siding installation for contractor and one helper took two weeks. This time included window flashing to project specifications and careful attention to detail.

Builder Survey Results

The following table summarizes builders' responses as to their likelihood of incorporating MADE concepts and technologies into their future homes.

Technologies / Design Concepts	Likely	Neutral	Unlikely
Moisture-Resistant OSB Subflooring	66%	0%	14%
Ductwork in Conditioned Space	48%	17%	10%
Stamped Concrete Exterior Walkways	38%	10%	24%
Tankless Water Heaters	41%	14%	28%
Precast Foundation Walls	21%	14%	41%
Fiber Cement Siding	52%	7%	21%
Split-face Concrete	24%	21%	41%
Air Admittance Valves	62%	10%	21%
Termite Shielding	28%	21%	34%
Rear-loading Garages	34%	10%	28%
18" Overhangs	55%	17%	7%
12" Overhangs	66%	3%	7%
No-step Entries	62%	7%	7%
Oversized Doors and Walkways	76%	7%	3%

Caulkless Fiber Cement Results

- According to the data and actual inspection of the house, there appeared to be no water leakage or moisture migration through the walls in normal weather conditions. The seven wetness sensors between the fiber cement siding and the house wrap showed no indication of wetness.
- The 22 moisture probes around the window area revealed no evidence of water intrusion.

FOOD FOR THOUGHT

- AAVs are installed at the final plumbing stage. Because AAVs require a sanitary tee behind the trap, offset the drain at the rough-in stage to allow for the vertical AAV installation.
- Apply two even coats of paint to pre-primed exterior fiber cement siding, rather than one thick coat, for an even luster and a long-lasting finish.
- A fiber cement siding system, when installed with careful attention to weather barrier and flashing detail, can be installed using only a minimal amount of caulk for aesthetics. This system does not rely on caulk to maintain its weather resistance which, over time, will prove to be more reliable than a system which relies on caulk.
- It is important to note that the MADE homes built in Bowie, MD, are just one interpretation of the MADE concepts. There are an infinite number of ways to incorporate features that appeal to perspective homebuyers. A key takeaway from this project it is that when trying to provide value at a reasonable cost, you must consider the marketability, affordability, and durability of the product throughout project design, planning and specification, and construction.

DOLLARS AND SENSE

Total House Costs (Hard)	\$61.84 to 62.41 per s.f. (on full basement) including sprinkler and \$2,036 sewer development charge
Installed Cost for Foundation Walls	\$18,500 to \$19,000 (not including excavation)
Termite Shield	\$250
Fiber Cement Siding	\$13,200 plus painting
New Generation OSB Subflooring	Cost falls between OSB and plywood
Structured Wiring	\$1,625 and \$1,459
Concrete Walkway	\$1,625 and \$1,150 for x s.f. (5-ft wide by X ft long)



The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, and affordability of America's housing. Managed by HUD, the PATH partnership includes the home building, manufacturing, insurance, and financial industries, and Federal agencies concerned with housing.

PATH addresses barriers to innovation, provides information on advanced building technologies, and advances housing technology research; making affordable, quality American homes a reality.

For more information on PATH, visit www.pathnet.org.
For more information on PATH field evaluations and innovative technologies, visit www.toolbase.org.

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 - Congoleum, Corporation
 - Home Automated Living
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 - Studor, Inc.
 - Weaver Precast, Inc., and Superior Walls of America, Ltd.
 - Toto, USA
 - Whirlpool Corporation

RESOURCES

- *A Builder's Guide to Marketable, Affordable, Durable Entry-Level Homes to Last, 1999*, NAHB Research Center; www.huduser.org/publications/pdf/made.pdf.