

“Debunking the “Un-healthy” Myth of Factory Built Housing and Its Use as a Superior Healthy Building Alternative”

Michelle Roberts & Rick Terry



Presenters Bios

Michelle Roberts

- Director at the NAHB Research Center
- Business Development Leader: Healthy and Energy Efficient Homes and Buildings for Owens Corning

“Michelle is charged to bring new commercial and residential innovations/specifications to the market place and also teach colleagues, architects, specifiers, general contractors, developers, building code officials, government agencies, and real estate professionals a deep and practical understanding of safe and healthy building science and systems. She has also spent several years consulting with and advising the modular home industry.”

Presenters Bios

Frederick “Rick” Terry

- Director of the Factory Built Housing Center at Penn College
- Program Manager for the Factory Built Housing Industry Partnership

“Rick’s background in the modular housing industry as part of a family manufacturing business, positioned him as the first director of the FBHC in 2004 to facilitate development of programs and applied research for the factory built housing industry in Pennsylvania and the eastern region of the country. Through out this process, Rick developed a passion for building science and sustainability in FBH construction; an area that he felt was disconnected from everyday construction in general.”

Indoor Air Quality (IAQ)

- Look at the major contributors to poor IAQ in residential structures
- Identify possible side effects of poor IAQ
- Identify recommended practices for improving IAQ
- Defining Modular Housing from a historical perspective
- Identifying challenges to IAQ in modular housing

Problem products which may include:

- Particleboard subflooring
- Paneling
- Cabinetry & furniture
- Hardwood plywood
- These frequently use urea-formaldehyde (U-F) resins in their manufacture
- For wood products these resins are used as interior-grade adhesives



Possible Reactions to U-F



- eye irritation, dry/sore throat, runny
- nose, cough, sinus irritation, sinus infection, headaches,
- unusual fatigue, depression, difficulty sleeping, rashes,
- bloody nose, nausea, diarrhea, chest pain, and abdominal
- pain

Temperature & Humidity*

*As a general rule, in the temperature range of 65 to 86 degrees F, a temperature increase of 10 degrees F will result in an approximate **two-fold increase** in formaldehyde levels.*

*An increase in relative humidity from 30-70% can be expected to result in an approximate **40% increase** in formaldehyde levels.*



Recommended VOC Source Reduction Practices For New House Construction*

1. When alternates exist, avoid wood products with urea-formaldehyde resin system.
2. Construct cabinet cases with fully encapsulated wood products.
3. Use frameless cabinets to eliminate MDF stiles.
4. Apply laminate backing sheet to undersides of PB countertops.
5. Use alternate low-formaldehyde emitting passage doors.
6. Apply barrier material over plywood subfloor in carpeted areas.

* **Manufactured Housing Indoor Air Quality Study**, *Plant City, Florida, and FSEC MHLab*

Modular Housing and IAQ



Where did we come from?

The roots of Factory Built Housing (FBH)...

SIX ROOMS AND BATH



The BANDON **Home-Built** \$4,275⁰⁰
 No. 2055 Cut and Fitted.

See Description of House on Page 2.



At the above price we will furnish all the material to build this six-room house, including kitchen cabinet, medicine chest and mantel. We guarantee enough material to build this house. Price does not include cement, brick or plaster.

THE BANDON is a neat, practical and modern design very much in favor with discriminating builders.

Main Floor From the pleasant shelter of the big front porch one enters the attractive living room. If the French doors to the left happen to be open one can look into the cozy dining porch or sun room. In the living room the fireplace is opposite the French doors and the center of a pleasing group of windows and eared opening. Balustrade and good proportions characterize the room. In the dining room there is space directly opposite the eared opening for a buffet or china cabinet.

Bedrooms, bath, linen closet, white wains and kitchen all open off the hall. Each bedroom has a window, large closets and doors to the 14-foot sleeping porch.

Any part of the house or important part is quickly reached from the kitchen, yet the work is carried out of sight. Sink and stove are together and used by two happy children. Windows on both sides of the kitchen and those together with the glass door leading to the sun room will make it a pleasant work room. At large entrance above space for refrigerator is a large shelf for vegetables, this room being cooler than the kitchen. The glass to the outside door behind the landing. Stairs set to lead down from the ceiling.

Basement Exceptional basement under the entire house 7 feet from floor to finish, finished with concrete walls, with five cool basins to wash, all rooms are in beautiful green and white. Windows are made of clear California white glass, with good opening glass set in with lead glass or zinc.

Paint for three coats outside; good choice of colors. Varnish and wood floor for inside of house. Chicago Design hardware on page 104. Built on a concrete foundation. No. 2 white pine framing lumber. Clear exterior siding. Roofed with Five-Cent Shingles Red Machine, and-Black for 11 years.

OPTIONS
 Sheet Plaster and Plaster Finish to take the place of wood siding, \$20.00 extra.
 Oak Doors, Trim and Floors in living room, dining room and sleeping porch instead of yellow pine, \$200.00 extra.
 Maple Flooring for kitchen, parlor and hallways instead of yellow pine, 90 extra charge.
 Storm Doors and Windows, \$110.00 extra.
 Screen Doors and Windows, \$60.00 extra.
 \$41.00 extra; polished iron, \$20.00 extra.

This house can be built on a lot 20 feet wide.

For prices of Plumbing, Heating, Wiring and Electric Fixtures see page 103.

Attic finished with two rooms, \$150.00 extra.

If mantel is not wanted, \$22.00 less.

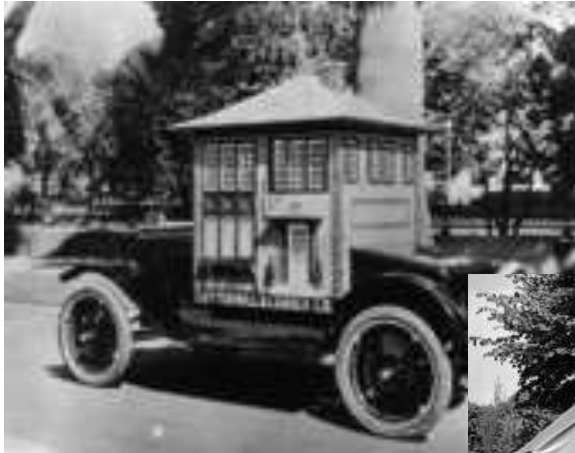
Our Guarantee Protects You—Order Your House From This Book.
 Prices Include Plans and Specifications.

SEARS, ROEBUCK AND CO. CHICAGO

Modern factory built housing dates as far back as the early 1900's with the advent of the Sears & Roebuck homes, purchased out of a catalog and shipped to the customer several weeks later in 30,000 pieces via railcar!



After World War II, wartime factory production was quickly changed over to providing consumer products to a post war time economy. Some of these manufacturing techniques were converted to the housing industry.



After the war, pent up demand for housing created a surging market that suited the production process. The manufactured housing industry saw dramatic increase in popularity as the nation's citizens became more transient after the war.

As the demand for labor in the manufacturing sector increased, the availability of skilled labor in construction began to feel the pressure.

The 1960's and early 1970's saw an adaptation of the manufactured process for homes to create a "modular" product.





This was basically a site built or “stick built” home completed in two units or more, transported to the building site on flat bed frames and then erected onto a permanent foundation.



Manufactured and modular construction both grew substantially during the late 1970's and into the early 1980's. During this time, traditional builders (stick builders) struggled to keep up with demand.



Designs of modular homes moved from the typical ranch style to more complex split level, Cape Cod (1 ½ story) and two-story homes.

Multiple roof lines, customized exteriors, and contemporary designs also began to develop.

During the mid to late 1990's home manufacturers began to build larger and more complex projects and contributed to the "McMansion" craze of the early 2000s.





Commercial applications of modular construction like motels, offices and school classrooms began to emerge throughout the 80's, 90's and accelerated in the 21st century...





Modular building systems have seen an increase in production as skilled labor and materials increase in demand, modular construction will see continued growth as an alternative building method for those seeking top quality construction at a competitive price.

Modular Housing Represents Nearly 22% of All Housing Starts in the Northeast!

**PA has the most
modular
manufacturers in
the country with
37 plants!**



Modular is NOT a Manufactured Home!

- Manufactured or HUD code homes are built to a federal code
- Some traditionally manufactured housing plants now building some modular “qualified” products based on their HUD products adding additional confusion
- Separate ENERGY STAR® protocol

Manufactured vs. Modular



Manufactured (HUD)



Modular (IRC)

Manufactured vs. Modular

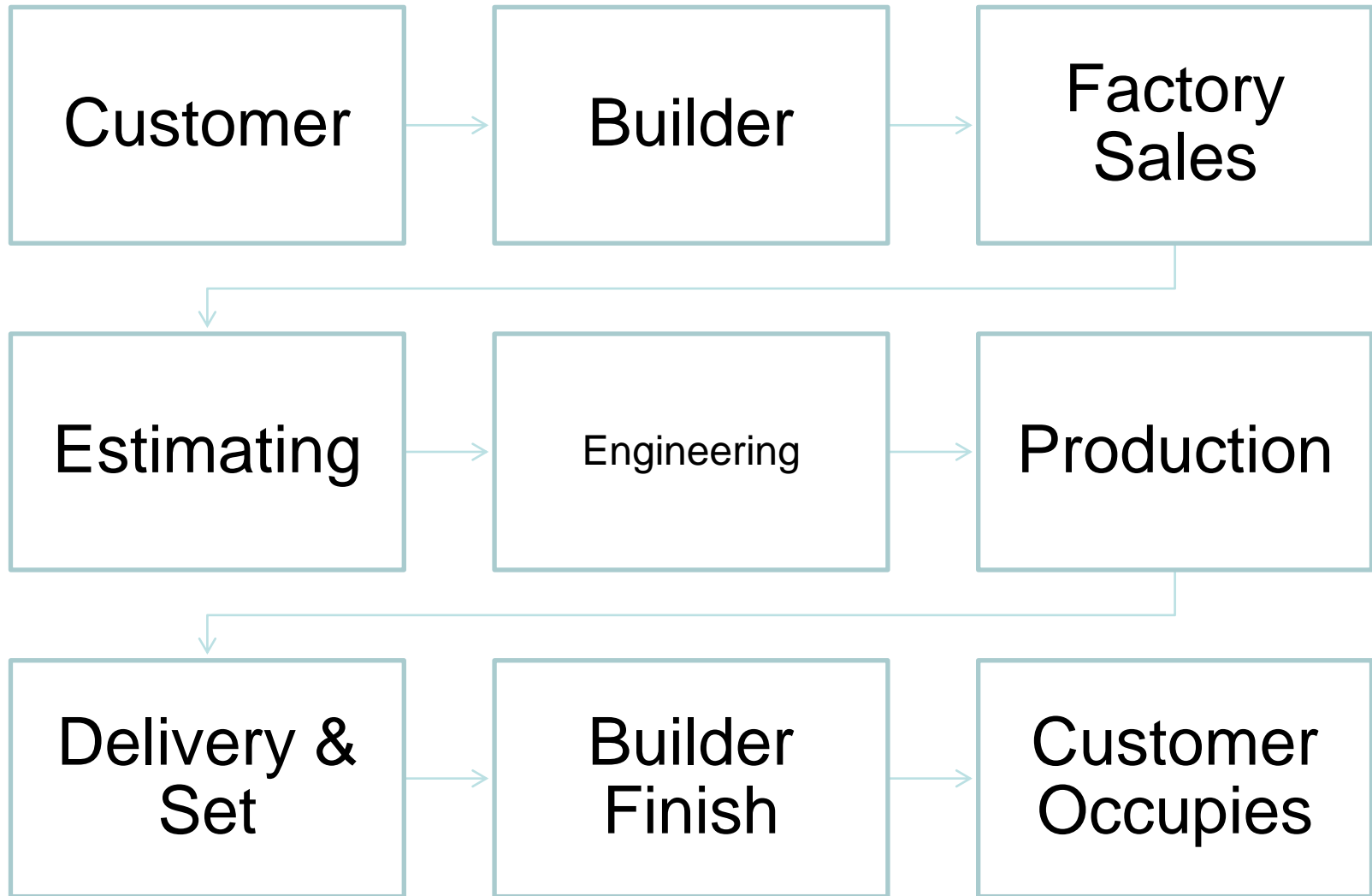


Manufactured (HUD)



Modular (IRC)

The Modular Building Process



Modular and Sustainability

Inherently Green

- Very efficient system of production
- In plant construction waste reduced to nearly 15% of similar on site construction
- Materials stored in protected environment
- Modules constructed in protected environment



Michelle Kaufmann Designs™

GREEN in Modular Manufacturing

Recycling Materials

- Aluminum
- Copper
- Drywall
- Vinyl Siding
- Wood
- Cardboard
- Paint Containers
 - 330 Gallon Paint Containers

Efficient Use of Materials

- Computer Aided Drafting or “CAD”
- Framing layouts engineered to maximize use of wood
- i.e. a 2”x10” Floor Joist is cut and the remaining piece used as floor bridging
- Even Drywall Mud!

Green Materials in Mods

- Low “E” Windows and glass doors
- Bamboo Wood Flooring
- PEX plumbing vs. Copper
- Tank less Water Heaters
- Energy Star® certified mechanical ventilation & appliances
- Engineered Wood Products
- Hi-Performing Insulation & Air Sealing Products



Modular and Green

- ▶ Materials that would normally be scrap or waste on site projects is used in home where possible
- ▶ Central location to construct 85% of overall home
- ▶ Time to construct is dramatically reduced compared to traditional on site construction

Building Systems Awards Best Green Modular Home to



BUILD GREEN

Best Green Modular Home Design



2009 AWARD WINNER
Excellence in Marketing & Home Design



The Greenfield design, constructed by Simplex Industries and turnkeyed by Cornerstone Building Solutions (Scranton, PA), earned top honors in the green built, modular category in the Excellence in Home Design awards from the Building Systems Councils of the National Association of Home Builders.

This design is the centerpiece of the Simplex Planet Friendly Homes Program, a new line of designs from Simplex designed to tread lightly on the earth while saving energy and increasing the quality of life for its homeowners, explains Dave Boricello with Simplex. The Simplex Planet Friendly Homes Program includes only the highest possible energy-efficient materials and appliances coupled with the industry's most intensive in-house recycling program overseen by a full-time recycling coordinator. This three- or four-bedroom model (depending on the configuration) meets or exceeds all Energy Star requirements and will see energy bills that are at a minimum 20% to 30% lower than conventionally built homes.

The Greenfield is green in every sense of the word. Its design includes:

- Energy Star 5+ rated home
- HERS index score of 50!
- Energy Star-rated bath lights and fan lights
- Energy Star-rated kitchen appliances
- Energy Star-rated light fixtures with fluorescent lamps
- Energy Star-rated windows and patio doors with foam air sealant
- All receptacles and switches on exterior walls sealed with foam in wall cavity and feature foam gaskets under the cover plates
- Bottom and top plates in the walls are sealed with caulk bead where they attach to floor and ceiling
- R-8 duct work P/O R-6 duct work
- High density R-21 insulation in walls, R-

JUDGES SAID

- "Great green features!"
- "Spacious garage."
- "This is an amenity-rich home in an eco friendly, small design."






38" in ceiling, R/O high density foam in crawl space

- 90% high efficiency furnace
- Noritz on-demand tankless hot water heater
- Moen low-flow faucets in bathrooms
- Low flush 1.28 gallon TOTO Drake Eco toilets
- Small footprint for a large scale home
- Any excess building materials were recycled during construction

■ BUILDING SYSTEMS
JANUARY | FEBRUARY 2009



Green Initiatives of FBHC & CPFBHIP

- Work with companies on implementing Green strategies into product line
- Conducted Green Advantage and NAHB Green training programs
- Trained modular manufacturing QA personnel as RESNET Field Rater Inspectors
- Strategy was to base actions on national programs to be able to react to any national, regional, state, or local Green initiatives

What are we seeing in plants...

Initially...

- ▶ No consistent contact person in plant
- ▶ ES process initiated with Rater after house on line
- ▶ Grade III or failing fiberglass insulation work
- ▶ Personnel changes after training in proper techniques
- ▶ Lack of air sealing strategies in place or sufficiently completed

Today...

- ▶ Plants starting to designate ES/Green specialist
- ▶ Starting to get activity in sales phase or early production phase
- ▶ Insulation work seeing great improvements; majority are Grade II/III
- ▶ More air sealing strategies recognized and implemented
- ▶ Still room for improvement!

Challenges to Sustainability with Modularity

- Lack of contact between customer/builder and manufacturer at beginning of sales process
- Manufacturers not involved in site aspect of planning and design
- Lack of education/training with all stakeholders
- Lack of enthusiasm with sales staffs
- **Fear of additional costs by consumers, builders, manufacturers!**

Modular Industry IAQ Survey



Overview – Modular Construction

- ▶ Continue to educate and train industry staff and builders using a Building Science foundation
- ▶ Breakdown certification process and develop training that integrates into existing process
- ▶ Utilize grants and incentives to entice entry into Green market and philosophy
- ▶ Constantly reinforce benefits and true cost “savings” by going Green (with emphasis on Energy and Indoor Air Quality)
- ▶ Establish Partnerships to spread message and opportunities with like minded organizations!

Summary

- Continue to introduce readily accessible, IAQ friendly materials to the modular building process
- Facilitate a sustainable culture change within modular organizations
- Invest in a “Sustainably Educated Workforce”
- Educate the building and consumer communities on the sustainable advantages of modular construction

Questions?



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