Innovations in Affordable Single Family Home Construction

by Sam LaTronica
Goals

1. Affordable for lower-income potential homebuyers
   • Upfront and long-term costs
   • Ideally requires no subsidy on development side

2. Environmentally sustainable
   • Green and recycled materials
   • Energy efficient

3. Healthy
Innovations

Small  Factory-built  Creative

[Diagram with circles and interconnections]
Definition:

• “Small” is relative to the market.
• For Midwest CDCs, smallest single family homes range from approximately 900 - 1,100 square feet.
• Census:
  Under 1,400
  1,400 - 1,799
  1,800 - 2,399
  2,400 - 2,999
  3,000 - 3,999
  4,000 +
Small

Opportunities

• Fewer materials
• Shortened construction time
• Long-term savings on utilities and maintenance
• Can fit on smaller and irregular infill lots
• Growing interest in certain markets

Challenges

• No guarantee that construction costs will be much lower
• Could stigmatize affordable housing
• Data suggests that most markets aren’t ready for smaller houses
Small

Median Size of Newly Constructed Single Family Homes in Square Feet

Data Source: US Census
Small

Market Share of Different Home Size Ranges (as a percent)

Data Source: US Census
Small

Home Size Ranges by Type of Sale (as a percent)

Data Source: US Census
Our Interest in Manufactured Housing

What is Factory Built Housing?

Innovations in Factory Built Housing

Although Manufactured Housing (MH) refers to both mobile and manufactured homes, it is a significant source of affordable housing for lower income households, particularly in rural areas. 91% of all MH is located outside of central cities. 79% of all MH households make below the national median income, 25% live below the poverty line.

MH accounts for 14% of all non-metro housing. Designed to meet local, state, or regional codes, MH is less expensive for residents. Median monthly housing costs for MH dwellers ($545) are much lower than the national median for all occupied units ($927) and the median for multifamily units ($824).

Low costs are part of the reason that MH is so disproportionately popular with lower income households. The cost per square foot to build a new manufactured housing unit ($41.37) is less than half the cost for a new single family site-built home ($86.30). MH is also less expensive for residents. Median monthly housing costs for MH dwellers ($545) are much lower than the national median for all occupied units ($927) and the median for multifamily units ($824).

What is Factory Built Housing?

Factory-built housing is an incredibly diverse segment of the housing construction business, encapsulating much more than the pejorative stereotype of a ‘trailer park’. In fact, the diversity of factory-built housing includes wide', 'kit' homes; all parts are cut and prepared in a factory, ready to be constructed on site, 'panelized' building systems in which walls are factory built and assembled on a prepared foundation, 'modular' homes and 'heterogeneous' factory built units constructed on a steel chassis as of June 15th, 1976. Designed to meet local, state, or regional codes, these homes are a significant source of affordable housing for lower income households, particularly in rural areas.

The Housing Construction Spectrum

 NeighborWorks uses the below terms to classify housing construction style.

- **Site-built**: A unit constructed entirely on its own lot; also referred to as ‘stick-built’.
- **Pre-Cut**: ‘Kit’ homes; all parts are cut and prepared in a factory, ready to be constructed on site.
- **Panelized**: Constructed using a panelized building system in which walls are factory built and assembled on a prepared foundation.
- **Modular**: A unit made of factory built modules put together on site.
- **Manufactured**: A factory built unit constructed on a steel chassis as of June 15th, 1976 designed to meet federal ‘HUD’ code.

*Image credit: NeighborWorks*
Factory-Built

Modular
Factory-Built

Modular
Factory-Built

Modular
Factory-Built Modular
Factory-Built

Modular
Factory-Built

SIPs

Image credit: www.buildingsonfire.com

Image credit: www.coloradotimberframe.com
Factory-Built

SIPs

Image credit: http://tightlinesdesigns.com

Image credit: http://buildipedia.com
Factory-Built

Opportunities

- Efficiency of factory conditions
- Shortened construction time
- Consistency can stabilize production cycle
- Greater structural integrity
- Efficient use of materials
- SIPs provide a much tighter building envelope

Module Dimensions:
Length: < 68’ is best, 76’ max
Height: 15’6” or less is best, 16’ max
Width: 16’ most economical, 18’ max

Maximum dimensions increase transportation costs
Modular construction significantly lowers the cost of construction in the city.
Factory-Built

Challenges

• More potential in higher-cost markets
• Often more complicated than anticipated
• Transportation issues
• Suppliers prefer higher-volume
• Capacity of local labor force
• Local codes and inspections
• SIPs can be compromised if they get wet
• Tighter envelopes require expensive ventilation systems
• External design is limited
Factory-Built

Construction Typology (as a percent)

Data Source: US Census
Construction Typology by Type of Sale (as a percent)

Data Source: US Census
Factory-Built

Modular

Map data ©2015 Google, INEGI

Data Source: Modular Building Institute
Design Innovations

Techniques that can be used in conjunction with smaller or modular or smaller housing to get to the most affordable price point. Examples include:

- Accessory Dwelling Units (ADUs)
- Cohousing
- Unfinished space
- Easy build-outs
- Efficient use of space
- Replicability
- Flexible exteriors

See HUD’s “Building Innovation for Homeownership.”
Creative

Shared Amenities:

Central building, covered patios, garden, protected bike racks, edible foliage
Creative

FUTURE PATIO OR DECK

GARAGE - 2 CAR

DINING 11'9" x 9'8"

KITCHEN 13'3" x 13'2"

LIVING 16'0" x 13'2"

PORCH

BEDRM 1 10'3" x 13'2"

BATH 1

BATH 2

BEDRM 2 9'8" x 10'9"

BEDRM 3 9'3" x 10'9"
Case Study

Next Step

“Next Step is the first and only national strategy and scalable approach to bring factory built homes to nonprofits nationwide. We aggregate demand for the factory built housing industry by organizing, brokering and training nonprofits on the Next Step System for doing business.”
Case Study

The Brookdale
1,232 square feet
3 bedroom
2 bathroom

- Open floor plan
- Eat-in kitchen
- Great closet space
- 28’ x 44’
- 2x6 Exterior walls
- 2x4 Interior walls
- ENERGY STAR construction
- ENERGY STAR appliances
Case Study

**Discovery A**

- 1,024 square feet
- 3 bedroom
- 2 bathroom

- Open floor plan
- Great closet space
- 16’ x 64’
- 2x6 Exterior walls
- 2x4 Interior walls
- ENERGY STAR construction
- ENERGY STAR appliances
Lessons Learned

- Manufactured housing is key to affordability - otherwise CDCs are using a subsidy
- Decreasing footprint doesn’t reduce cost without producing greater volume
- Variation drives cost
- Exploring “Tiny Homes”
- Have experienced supply chain issues with top national producers
- Most markets are not adopting small designs
- CDCs sometimes add green features until they see the cost
Case Study

Southwest Minnesota Housing Partnership

“The Southwest Minnesota Housing Partnership is a non-profit community development corporation serving thirty counties in rural Minnesota. We aim to build strong and healthy places to live so that the communities of our region thrive.”
Lessons Learned

• Integration of disciplines within CDC is crucial
• Efficient space makes small more palatable
• Setting modules in place is highly complicated
• Develop strong relationships with builders
• Address accountability early
• Labor shortage can drive up prices
• There is a learning curve, but it is important to follow through
• Keep an eye on suppliers throughout process
• More potential for modular in multi-family project due to economies of scale
423 Armstrong St., Kansas City, KS

Developer: Community Housing of Wyandotte County (CHWC)
Architect: Clockwork Architecture + Design

Bedrooms: 2  
Bathrooms: 2  
Square feet: 1,107  
Total Development Cost: $215,607  
Sales Price: $159,900  
Development Subsidy: $65,000 (grant)  
Construction Typology: SIPS (first floor), Stick Framing (roof)

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<thead>
<tr>
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<th>State</th>
<th>County</th>
<th>City</th>
<th>Tract</th>
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<td>% of Income</td>
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<tr>
<td>Median Gross Rent</td>
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<td>Rent as % of Income</td>
<td>28.10%</td>
<td>31.70%</td>
<td>32%</td>
<td>27.20%</td>
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</table>
Case Study

Overview

• First home constructed using SIPs by CHWC
• Built on small urban infill lot
• Development costs exceeded predictions
• Single finished floor with open-floor style plan for living space
• Second unfinished floor can be converted into more livable space
• SIPs chosen over full-modular construction due to proximity of suppliers and infill constraints
Case Study

Goals

• Adaptable to different neighborhoods and potential buyers
• Replicable and scalable for future production
• Better performance at a comparable price, or comparable performance at a lower price
• Efficient use of limited space
• Affordable over lifespan
Positive Outcomes

- Seen by CHWC as a successful first attempt
- Building envelope is much tighter
- Less susceptible to thermal bridging
- R-factor for these SIPs is 27, compared with R-factor of 13 (stick-built homes)
- Noise insulation
- Despite higher price, home “would be affordable to a family of 3 at 80-100% AMI... given the projected lower operating costs.”
- Healthier home
- High interest in design
- Actual construction took only three months to complete, compared with six months for stick-built
Challenges

• Unusual site-specific costs associated with lot
• Difficult to get bids - “not a system that most residential builders work with.”
• Thin subcontractor market prompted hiring of outside general contractor
• Construction costs amounted to $113/square foot, while identical house built using traditional stick-built framing would cost only $110/square foot
• Biggest overall challenge was supply chain
• Major issues with contracts
Lessons Learned

• CHWC will continue to pursue SIPs
• Reusing existing design with in-house builders
• CHWC believes that if they were to build this house on the exact same lot a second time, it would cost $165,665, well below the as-built cost of $215,607.
• If built on traditional lot, estimated cost for house would be $140,630 (however, this is still more than the estimated $134,076 it would cost for stick-built framing)
• Developing new relationships and gaining experience
• Shorter construction time will yield savings and accelerate production
• Building multiple homes at once will save production and shipping costs
Lessons Learned

• Mixing construction typologies proved to be costly
• Converting existing plans to SIPs plans
• Strong relationships with all parties involved is one of the biggest requirements for successful modular and panelized construction
• CHWC recommends allocating plentiful time when pursuing new technology
• Pursue experienced SIPs architect and integrated services package if possible
179 Scranton St., New Haven, CT

Developer: NeighborWorks New Horizons
Architect: Yale School of Architecture

Primary Unit:
Bedrooms: 1
Bathrooms: 1
Square feet: 500

Secondary Unit:
Bedrooms: Studio
Bathrooms: 1
Square feet: 300

Construction Cost: $220,000
Sales Price: $155,000
Subsidy: Donations (materials and labor)
Construction Typology: Stick-Built

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<td>Median Owner Occupied</td>
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<tr>
<td>Median Gross Rent</td>
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<td>36.90%</td>
<td>34.20%</td>
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Case Study

The homeowners - perhaps a young couple - live in the larger unit and rent the upstairs studio to a tenant.

The tenant moves on to a larger apartment elsewhere; the owners install one door to convert the building to a 2-bedroom house to accommodate their growing family.

As their resources grow, the young family moves to a larger house and sells the building to a first-time homeowner who lives in the upstairs studio and rents the larger downstairs unit for extra income.

Eventually, the homeowner moves downstairs to the larger unit, and the cycle begins again.

Image credit: Neighborworks New Horizons
Case Study

Overview

- Two units within house
- Built by students of the Yale School of Architecture
- Innovative design enables multiple configurations of units
- Secondary unit can provide rental income
- Built on small infill lot in residential urban neighborhood
Goals

- Develop a “microhome” available for a buyer in New Haven
- Attract new and different buyers
- Flexible enough design to adapt to difficult infill parcels
- Offer rental income to primary tenant
Positive Outcomes

• House can be adapted to meet different needs
• Can provide rental income, alleviating the burden of high homeownership costs
• Interior designed for efficiency
• Lot placement
• Neighborhood embraced the design and development of vacant lot
• General design can be easily modified to fit irregular parcels
• Low-maintenance native plantings and garden
• Indoor/Outdoor strategies
Case Study

Image credit: Neighborworks New Horizons
Case Study

Challenges

- Didn’t meet goals of size or affordability
- Explored modular but did not pursue
- Certain flexible features too expensive
- Adding a second kitchen is costly
- Building house without Yale inputs would increase cost
Lessons Learned

- Potential buyers weren’t those anticipated - still trying to figure out the market
- Relationship with students is progressing
- Moving forward with a grant to build 7 more for an estimated TDC of $135,000 each
- Made adjustments to original design to improve efficiency and affordability
Final Takeaways

• There is no silver bullet. Markets are unique and can necessitate a combination of techniques and volume.
• Changing perceptions can be beneficial to affordability.
• Building strong, positive, communicative relationships at every step of the process is paramount.
• There are learning curves, but it is important to be persistent.
• CDCs are investing in learning. While mistakes are made while building prototypes, these mistakes can inform others who are exploring new techniques. It is crucial to learn from each other and share best practices.