
Modular Construction Feasibility Study for Vacant Lots in the Shaw Neighborhood



Map of Shaw Neighborhood Boundaries

Figure Source: Saint Louis Department of Planning and Cultural Resources



Shaw Neighborhood Vitality / Viability for Modular Development

Recent innovations have permitted the modular construction industry to make progress in developing processes and materials to deliver more stylish and intricate facility types. These innovations have brought modular construction into the public and into residential projects at an increasing rate. Several sources point to the financial benefits of modular construction, stating that it can provide up to 15% savings versus a traditional stick-built home¹. Other potential benefits of modular construction include: a quicker time from conception to occupancy², resource efficiency, and less environmental landscape degradation—reduced site damage, reduced material exposure as result of a controlled environment. A recent National Research Council report identified, “greater use of prefabrication/ modularization” as a key opportunity that could significantly improve the efficiency and competitiveness of the U.S. construction industry going forward³.

¹ EcoUrban Homes Modular Comparison; Finishwerks Modular Homes

² In many cases occupancy occurs 50% faster than with stick-built construction because of a streamlined construction process. Prefabrication can yield time savings through the ability to conduct work simultaneously onsite and offsite, as well as helping with better coordination among different trades. Unique to modular construction, while modules are being assembled offsite, the site can be prepared for modular units’ arrival which leads to quicker occupancy and reduces costs associated with labor, finances and supervision.

³ Modular Building Institute: Improving Construction Efficiency & Productivity with Modular Construction

A real estate analysis, completed in September 2011, indicated promising growth potential for renovation and investment in the Shaw Neighborhood of Saint Louis. During the previous twelve months, developers completed and sold approximately 12 renovated single-family properties⁴.

Shaw Renovation September 2010-September 2011	# of homes	Average sale price (\$)	Average size (sq. ft.)	Average # bed	Average # bath	Average days on market	Average % list to sale price	Average cost/ sq. ft. (\$)
	12	216375	2009	3	2.5	44	95.72	108

Source: Shaw Neighborhood Real Estate Market Data, September 12, 2011

These data, combined with historical precedent in the neighborhood, cause us to examine the prospects for new construction in the area. Despite recent growth, the neighborhood maintains its status as an urban area with room for improvement in some regards.

One major opportunity exists in the form of vacant lots. With this report, we aim to investigate modular as an alternative to traditional stick-built construction. Prefabrication and modular building processes are not new activities—63% of those that are using these processes have been doing so for five years or more.

Given that prefabrication/ modular construction has been around for many years, it is not unexpected that 85% of industry players today are using these processes on some projects. Among all players, the primary reason they are not using prefabrication and modularization on some or all of their projects is that the architect did not design it into their projects.

Modular vs. Stick-Built: Cost and Scope Comparison

Past projects in the region and specifically in South St. Louis have shown an overall savings with modular construction for an 1800 square foot residential project. Other sources reveal similar findings.

For the purpose of this study, it is assumed that all construction above the foundation can be included with a typical modular home. However, when considering infill neighborhood construction of a well-finished 1,800 square foot home it is recommended the flooring and exterior siding be completed on-site to better fit with the local architecture – as modular factories are limited to vinyl siding.

⁴ 4100 DeTonty Example

All excavation, site utilities, porches, HVAC hookups, plumbing connections, electrical connections and private walkways still have to be finished on site. A site contractor's scope of work is more than cut in half with the main structure completed and delivered under roof with primed drywall, windows, interior and exterior doors, electrical wiring, plumbing, cabinetry, ductwork, and trim.

Additionally, the flooring options from most modular factories are limited to carpet and vinyl and developers need to budget and be prepared to install most floor coverings. For example, if tile is selected, it is recommended to have the modular factory ship loose toilets for installation once the tile has been grouted. It is standard for all light and plumbing fixtures to come installed from the factory, but the options from most factories are not generally at the level expected by most buyers. However, in order to provide jobsite lighting and water use, it is recommend to take the base model installed for use during construction and then install the customer or developer selected fixture and donate the unused fixtures to the Habitat for Humanity ReStore. Also, if a finish or custom paint coat is desired, it is recommend having the modular factory leave outlet and light covers off to save additional time in the field.

Modular factories are working hard to improve their finish level and it is our guidance that the best approach remains to have as much work completed at the factory as possible. With this understood, many developers will still find the need to take this opportunity to give their buyer an opportunity for customization that can further improve the perception of modular versus stick-built.

Assessing Modular Feasibility and Addressing Concerns

Modular construction is ideal for certain situations and unfit for others. There are **four** basic stages in the design, planning, and implementation of a modular project.

Design approval by the user and relevant authorities Assembly of components in modular factory Transportation of modules to final site Assembly of modules into a finished structure

Of course, each of these processes has its challenges and associated costs while offering an alternative to conventional building operations.

- 1) Design approval by the user and relevant authorities:** Before beginning a modular project, it is important to assess the feasibility of modular for the particular project. The first considerations should be job site accessibility, building size, and the type of building exterior required. An extra consideration when building in an urban area is population density (Shaw population density is

equal to 13,738 persons per square mile). In dense neighborhoods, the building codes and specific regulations should be examined early in the process.

In the case of Shaw Neighborhood in Saint Louis, full architectural drawings must be submitted to Cultural Resources and the Building Division. Shaw is a Historic District⁵ and the protocol for such places (including Cultural Resources Division) must be followed before beginning a new construction project of any type.

The standards for rehabilitation and new home construction for the Historic District can be found [here](#). Some highlights of these standards include:

Any new construction, (residential, commercial, or any combination thereof), shall be of scale and character to complement both existing structures, the Grand Boulevard structures that exist in the Compton Hill Historic District on the east side of Grand Boulevard and the architectural character of the Shaw Historic District

New construction or alterations to existing structures: All designs for new construction or major alterations to the front of the buildings that require a building permit must be approved by the Heritage and Urban Design Commission, as well as by the existing approving agencies, as required by City Ordinances.

- 2) Assembly of components in modular factory:** The average modular factory can output around 158,000 square feet per year, an average of 232 “floors” or “modules”. Limited by a maximum width of 16 feet to accommodate highway transportation and a maximum length of 70 feet depending on the factory. However, the width is the most limiting factor in module size and design.

Theft and construction delays can be minimized in modular versus traditional building because the materials are available at the factory, all but eliminating material delivery fees and the exposure of materials to the elements. Typically, modular homes are initially stronger than traditional because they require lumber (10-20% more) to aid in durability in transport. Modules are also stronger because of the use of screws, rather than nails, and by adding glue to joints. Depending on the level of finish required by the owner and architect, the modules leave the factory 70-90% completed. Basic wiring, plumbing, structural, and mechanical systems have been independently inspected even before arrival at the site.

- 3) Transportation of modules to final site:** Modular manufactures are located throughout North America, with larger “clusters” of manufacturers in Pennsylvania, Georgia, Texas, Indiana, California, and Alberta. Most

⁵ [Shaw Historic District Ordinance](#)

manufacturers in North America are single location operations and can competitively transport units within a 300-mile radius of their factories.



Photo: Facility Management--Building Design

Typical module measurements

600-700 square feet
Width: 12 feet
Length: 50+ feet

- 4) Assembly of modules into a finished structure:** The placement of modules by crane (average cost of \$4500 per day) may take from several hours to several days – depending on the complexity of the design – with the average home being set in less than a day. Once assembled, modular buildings are essentially indistinguishable from typical site-built structures. A well-built modular building should have the same longevity as its site-built counterpart, increasing in value over time. Modular construction offers the benefit of flexibility in adding modules in the future if planned into the preliminary design.

The comparison of a modular and typical construction home are difficult given each site builder builds to different levels of finish. From a code perspective, there is no difference between the two methods of construction. However, most modular factories require 2 x 6 exterior framing while stick-built is usually done with 2 x 4 framing. This difference results in added opportunity for an additional 2” of insulation at a lower cost.

See **Appendix** for Pershing Home features used to estimate \$115 per square foot. This is a higher figure than one might see for a base model new home because research has shown that a base model new construction home would not compete well in the Shaw Neighborhood with buyers demanding more features.

In theory and to maximize savings, modular building offers fewer options for customization versus traditional building methods. However, economies of scale in the factory contribute to lower cost for modular (\$105 vs. \$115 for traditional). Modular building does not affect the cost or type of finish you can install. In most categories the brick façade, carpet, hardwood, countertops, fixtures, and 8’ foot basement generally cost the same regardless of the method of construction.

This estimate assumes both modular and a stick-built control home are built to the same level of finish (per our standard finishes). For the purpose of this study, it was assumed a brick front façade with fiber cement and the remaining walls, wood flooring on the first

floor with carpet on the stairs and 2nd floor. 42" maple cabinets with Formica countertops, upgraded fixtures and an 8' basement were included. A reader will notice a lower cost for kitchen and bath upgrades with modular due to the fact that kitchens and baths are generally completed in the factory resulting usually in fewer options for additional upgrades in these areas.

Of these basic finishes, there is limited cost-difference for the items that have to be completed in the field vs. the factory when comparing modular versus stick-built, but a 15 – 20% savings for items that can be completed in the factory.

Assuming both types of projects require financing, the savings from modular are greatest in the reduced contractor fees for the same scope of work and reduced interest and carrying costs due to the shorter construction time period (3 – 4 months with modular) vs. (5 – 8 months with stick-built).

In summary, based on a well-finished 1,800 square foot home, all else equal, modular offers a savings between \$10 – 15 per square foot less than stick-built. Additionally, the savings with modular increase as the number of homes built increases.

Comparing Costs: Modular vs. Stick-Built

Below is a general budget comparison between a modular 1,800 square foot home and a stick-built 1,800 square foot home with similar features.

Such a comparison reveals the possibility of meaningful savings with modular, particularly savings related to contractor and architectural services. Primarily, in reduced fees to a general contractor.

MODULAR VS. STICK BUILT CONSTRUCTION COST ESTIMATE

BASED ON 1800 SQUARE FOOT HOME

[See Appendix for more details on this comparison: Pershing Home](#)

	MODULAR BUDGET	STICK BUILT BUDGET	ESTIMATED SAVINGS
<u>USES</u>			
Property Acquisition	SAME	SAME	\$0.00
Site Work (Excavation/Foundation/Utilities)	\$40,000.00	\$40,000.00	\$0.00
Architectural	\$8,000.00	\$12,000.00	\$4,000.00
Buyer added selections	\$10,000.00	\$10,000.00	\$0.00
Engineering, Survey and Soils	SAME	SAME	\$0.00
Modular Home & Install	\$115,000.00	\$0.00	-\$115,000.00
Kitchen & Bath Cabinets & Countertops	\$2,500.00	\$10,000.00	\$7,500.00
Appliances	SAME	SAME	\$0.00
Onsite Construction Work	\$105,000.00	\$220,000.00	\$115,000.00
Garage	SAME	SAME	\$0.00
Construction Period Insurance	SAME	SAME	\$0.00
Construction Period Taxes	SAME	SAME	\$0.00
LEED for Home Certification	\$2,700.00	\$3,500.00	\$800.00
General Contractor Overhead/Profit	\$31,500.00	\$56,000.00	\$24,500.00
Total Development Costs	\$272,000.00	\$308,000.00	\$36,800.00

When looking at the premium for green and energy-efficiency improvements, it should be noted that there is a limited difference between a modular and stick-built home. It was discovered that modular homes tend to perform better in with reduced air infiltration – but a diligent on-site contractor could attain the same efficiency. Also, due to the off-site construction, there is much less construction waste with a modular home.

Attached (see Pershing Home in **Appendix**) is a specification of the modular home in our example. There would be limited differences in the scope of work for a stick-built home.

Conclusions

Based on this study and the examples provided, it can be said **definitively** that modular is more affordable by 5 – 10 % when building a single home, with greater savings realized at orders above 4 units. This savings is highly correlated with using a contractor familiar with modular versus a contractor that is new modular.

Construction Advantages of Modular

Modular Home

2 x 6 studs for exterior framing, creating a solid, strong frame
Exterior wall sheathing is glued and fastened, adding strength and decreasing air transfer
One-piece white "cool" rubberized flat roof with 30-year warranty, and much less maintenance than traditional roofing
2 x 10 floor joints and 2 x 6 ceiling joints provide added stability and noise reduction
All sub-flooring is glued and fastened to prevent warping and reduce noise
All drywall is glued from the inside of the wall to reduce the need for fasteners and opposing at the seam
High quality foam and R-40 insulation standing fills 2 x 6 exterior walls
14 SEER Heat Pump units provide substantially increased efficiency and decreased monthly utility bills
85% of homebuilding occurs off-site in controlled environment

Traditional On-Site Builder

In many cases, on-site builders use 2 x 4 studs exterior framing
Foam board is commonly used for exterior sheathing
Most new construction roofs are pitched with shingles
Most ceiling and floor joints are one piece, generally 2 x 8 or 2 x 10
Flooring is fastened with screws or nails
Most drywall is fastened with screws or nails
2 x 4 stud walls are usually insulated with R-13 insulation
13 SEER HVAC standard heating/ cooling in homes
Adverse weather conditions and theft impair progress of homebuilding



Appendix: Pershing Home Sample Budget and Scope of Work
 (Budget includes 3.6kwh solar PV & 5 ton geothermal system and garage)

ECOURBAN CONSTRUCTION COMPANY, LLC

Pershing Residence - 2176 sq. feet
DEVELOPMENT COSTS

	ORIGINAL BUDGET	APPROVED CHANGES	REVISED BUDGET
<u>SOURCES</u>			
Buyer Equity	\$348,215.00	\$0.00	\$348,215.00
Total Sources	<hr/> \$348,215.00	<hr/> \$0.00	<hr/> \$348,215.00
 <u>USES</u>			
Pre-Mod Construction Site Work	\$44,015.00	\$0.00	\$44,015.00
Architectural	\$8,000.00	\$0.00	\$8,000.00
Buyer added selections	\$4,200.00	\$0.00	\$4,200.00
Engineering, Survey and Soils	\$1,075.00	\$0.00	\$1,075.00
Modular Home & Install (Homeway)	\$139,000.00	\$0.00	\$139,000.00
Kitchen & Bath Cabinets & Countertops	\$5,350.00	\$0.00	\$5,350.00
Appliances	\$5,000.00	\$0.00	\$5,000.00
Post-Modular Construction Site Work	\$84,075.00	\$0.00	\$84,075.00
Construction Interest Est. Cost	\$0.00	\$0.00	\$0.00
Garage	\$18,000.00	\$0.00	\$18,000.00
Loan Fees, title, recording and disbursing	\$0.00	\$0.00	\$0.00
Construction Period Insurance	\$550.00	\$0.00	\$550.00
Construction Period Taxes	\$250.00	\$0.00	\$250.00
LEED for Home Certification	\$2,700.00	\$0.00	\$2,700.00
General Contractor Overhead/Profit	\$25,000.00	\$0.00	\$25,000.00
EcoUrban Professional Development Services	\$11,000.00	\$0.00	\$11,000.00
Total Development Costs	<hr/> \$348,215.00	<hr/> \$0.00	<hr/> \$348,215.00
	 PER SQ. FT.		
	=		
	\$160.03		

Pershing Home Modular Scope of Work Summary for Comparison

Floor Construction:

- Install and provide all structural steel basement posts
- Install sill sealer between all concrete and wood plates
- Furnish and install Treated sill plates for Superior Walls foundation
- Floor joists- Open joist 2009 9-1/4" @ 16" o.c. bottom chord bearing
- Sub-floor- 3/4" tongue and groove OSB, nailed and glued to joists

Exterior Walls:

- Studs – 2 x 4 @ 16" on center
- First floor ceiling height 9'
- Second floor ceiling height 9'
- Exterior wall sheathing – 7/16" OSB
- Tygar house wrap installed on exterior stud walls

Interior Walls:

- Studs – 2 x 4 @ 16" on center

Stairs:

- Stairs to second floor included, pine stringers, risers, and treads
- Stair railing and balusters to second floor not included, on-site
- Basement stairs shipped loose, installed on-site
- Does not include walls or stair railing in basement level

Roof Construction:

- Roof pitch 0.25/12 slope to rear of building
- Roof sheathing -5/8" OSB
- Includes ISO Tapered foam board insulation, rubber roof on top of modules
- Finish and sealing of rubber @ mating wall parapet with alum cap-Homeway

Second Floor Patio:

- Master suite patio to include rubber roof
- Teak deck paver and platform, on-site

Siding:

- All siding and trims are deleted, to be provided and installed by Owner

Millwork:

- Interior doors to be White 6 panel Masonite (later upgraded for \$2,000)
- Interior base to be White colonial wood base (later upgraded for \$1,000)
- Interior casing to be White colonial on all doors (later upgraded for \$500)
- Window sills to be White 1x trim
- Any on-site trim labor completed by others

Garage:

Garage material and labor by others

Gutters:

All gutters, downspouts, scuppers, copings, and cornices by others

Insulation:

“Energy Strength” Closed Cell Polyurethane Foam insulation in exterior walls to be 3” (R value = 20.4, ETP value = 29)

“Energy Strength” Closed Cell Polyurethane Foam insulation in ceiling joints to be 2” (R value – 13.6) plus R-11 fiberglass batt, plus ISO board r=9

Total ceiling/ roof R value = 33.6

Exterior Doors:

Front door to be excluded, on-site

Rear door to be 6 panel insulated steel door with alum clad jamb/ deadbolt

Master patio door to be full glass insulated steel door

Windows:

Windows to be Andersen 400 series windows

Interior to be painted white

Windows do not have grilles

Style, location and size per plans

Includes basement windows shipped loose, installed on-site

Interior/ Exterior Door Hardware:

Interior and exterior door hardware to be Georgian knob style

Exterior doors shall have deadbolt locks

Interior Wall & Ceiling Finish:

All walls to be ½” drywall with orange peel finish

All ceilings to have 5/8” drywall with orange peel finish

Windows sides and top to be drywall returned

All on-site drywall repair and patching by others

Finish Flooring:

All flooring to be on-site by owner

Painting:

All walls and ceilings to be finish painted off-white with Low-VOC paint

All on-site paint patching by others

Fireplace:

Fireplace by others

Closet Shelving:

Shelving to be standard wire coated

Cabinets, Vanities, and Countertops:

All kitchen and bath cabinets and countertops to be installed on-site

Plumbing:

All plumbing fixtures (toilets, tubs, showers, sinks, and faucets) by others

Kitchen sink and faucet not included

Water heater by others

Exterior frost-proof hose-faucet

All water lines are PEX, all waste and vent lines in PVC

All on-site connections and finish plumbing by others

Electrical:

200 amp multi-breaker panel

2 weatherproof exterior GFI outlets

5 combo TV/ phone jacks

Standard globe light fixtures in bedrooms

Standard vanity lights in bathrooms

Includes 18 standard recessed can lights

Includes 4 ceiling fan preps only

110 cfm exhaust fans in all baths

Coach lights at all exterior doors

Includes 12 keyless light fixtures installed and wired in basement

All wiring in Romex, conduit is not included

All on-site meter, electrical connections, and hookups by others

TOTAL PROPOSAL:

\$136,792.00

Total proposal includes transportation and setting of modules. Proposal does not include crane cost to set modules