

April 2019

Modular Construction: A Solution to Affordable Housing Challenges

John Thompson
Cornell University

Follow this and additional works at: <https://scholarship.sha.cornell.edu/crer>

Part of the [Real Estate Commons](#)

Recommended Citation

Thompson, J. (2019). Modular construction: A solution to affordable housing challenges. *Cornell Real Estate Review*, 17, 90-97.
Retrieved from: <https://scholarship.sha.cornell.edu/crer/vol17/iss1/21/>

This Article is brought to you for free and open access by The Scholarly Commons. It has been accepted for inclusion in Cornell Real Estate Review by an authorized editor of The Scholarly Commons. For more information, please contact hotellibrary@cornell.edu.

Modular Construction: A Solution to Affordable Housing Challenges

Abstract

The lack of affordable housing is pervasive across the United States. It affects some locations more severely than others, with each having unique challenges. Construction and land acquisition costs are frequently cited as primary drivers of multi-family housing development, and affordability is determined by a geography's housing costs versus its median income. This paper highlights crucial components in the connection between economic conditions, public policy, and affordable housing development. It focuses on how efficiencies in modular construction present opportunities for addressing specific challenges in Maine and will propose a strategy for public-private cooperation, particularly in the site selection process, in order to streamline the state's affordable housing agenda.

Keywords

Modular Construction, Affordable Housing, LIHTC, Low Income Housing, Maine

Modular Construction: A Solution To Affordable Housing Challenges



Author: John Thompson

John Thompson is a Master's candidate in Cornell's Baker Program in Real Estate, class of 2020. John received his B.S. in Business Administration from Babson College in 2012, focusing on Technology and Entrepreneurship. His professional experience involves a variety of commercial construction management projects in the US Northeast. Upon graduation he will pursue residential and multifamily development using state-of-the-art prefabrication technology.

INTRODUCTION

The lack of affordable housing is pervasive across the United States. It affects some locations more severely than others, with each having unique challenges. Construction and land acquisition costs are frequently cited as primary drivers of multi-family housing development, and affordability is determined by a geography's housing costs versus its median income. This paper highlights crucial components in the connection between economic conditions, public policy, and affordable housing development. It focuses on how efficiencies in modular construction present opportunities for addressing specific challenges in Maine and will propose a strategy for public-private cooperation, particularly in the site selection process, in order to streamline the state's affordable housing agenda.

THE AFFORDABILITY PROBLEM

Housing affordability has plummeted in markets across the United States. Developers have shunned affordable housing due to insufficient returns and complex financing processes. The crisis has no apparent solution, so government intervention has been deemed necessary for housing millions of at-risk Americans. The most common form of government housing assistance is the Department of Housing and Urban Development's (HUD) Section 8 program. The program provides housing vouchers to residents making between 30-80 percent of the area median income (AMI), so that they may select the most suitable housing options. Other solutions include the U.S. Department of the Treasury's Low-Income Housing Tax Credit (LIHTC), which offers an income tax incentive to developers who elect to designate a certain portion of their units in multi-family developments as affordable.

A. A Brief History of Supply and Affordability in the U.S.

The 1930's brought unique challenges to housing affordability due to displacement caused by the Great Depression. In 1934, Congress created the Federal Housing Administration (FHA), which helped make home ownership possible for disenfranchised Americans by providing access to long term mortgages with low down payments (NLIHC, 2015). Public housing appeared in 1937 through the U.S. Housing Act and in 1965 Congress created the cabinet office of Housing and Urban Development. Along with the U.S. Department of Agriculture's (USDA) Rural Development program, these are the primary players in today's government subsidized housing programs (NLIHC, 2015).

Beginning in the 1970's, oversight of public housing and the allocation of federal funds was handed down to state and local regulatory bodies. This shifting of responsibility allowed geographic areas flexibility in addressing the

specific needs of their communities, which, as we will see later, varies widely. In addition to funds appropriated by Congress, states and municipalities can generate their own housing assistance initiatives—often presenting themselves today as ad hoc agencies with particular sets of values and goals. This has been an increasingly important source of funding for high-need families, as federal policy has tended towards disinvestment in housing programs in recent decades (NLIHC, 2015), and market forces and philanthropy alone cannot meet the deficiency.

B. Current Solutions Fall Short of the Mark

In eight short decades, the political environment for housing assistance has changed dramatically, causing the financing of affordable housing projects to grow frustratingly complex. Such development projects often contain over 20 investment sources, each essential to the capital structure. Most of these different sources are independent of one another and contain different application processes and timelines. Developers must be diligent about fulfilling guidelines and reporting requirements as well as the requirements of their own equity investors (Blumenthal et al., 2016). Outside of Massachusetts and Michigan, no state entities coordinate the myriad public funding sources.

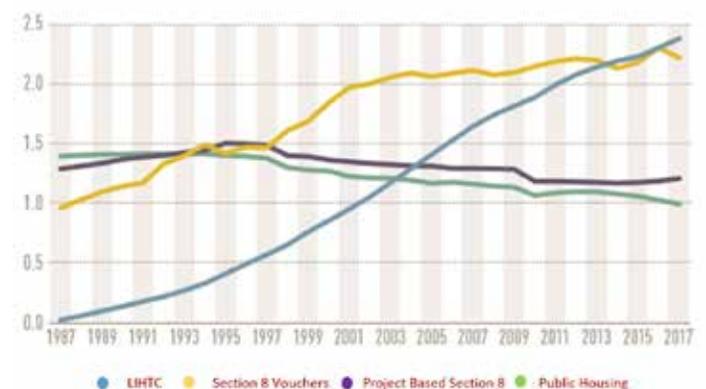


Figure 1. Common sources of housing subsidies for Low-Income Housing projects. Source: JCHS tabulations of HUD, 2015.

Administered by the US Treasury, the Low-Income Housing Tax Credit is currently the most important funding source. It is utilized in most subsidized development projects, having supported nearly 2.5 million projects since its inception in 1986 (Joint Center for Housing Studies, 2018) and is currently the largest source of subsidized housing, surpassing Section 8 Vouchers in 2016.

One of criticisms of the LIHTC program, however, is that it provides self-defeating incentives. In *Rethinking Federal Housing Policy*, Glaeser and Gyourko explain how LIHTC is an incentive for developers to provide housing only for the highest earners in low-income designations, without any compulsion to go above the minimum requirement (Glaeser & Gyourko, 2008). Moreover, the LIHTC program is sensitive to sweeping changes in tax policy, such as the 2018 Tax Cuts and Jobs Act. The reduction in the corporate income tax rate has effectively reduced the value of LIHTC projects, creating difficulties for developers seeking competitive returns.

Conversely, housing voucher programs like Housing Choice (previously known as Section 8) directly benefit recipients by allowing them to choose from existing accommodations, whether close to medical facilities, schools, or places of employment, they find most suitable. Voucher programs have had successes, but remain incapable of facilitating enough housing to meet demand. Wait times for vouchers have exceeded 30 months according to HUD's Worst Case Housing Needs report, and additional funding of \$12 billion from 2005-2015 has increased the availability of subsidized households by a mere 150,000, amounting to \$80,000 per household. Meanwhile, the number of additional very low-income households has exceeded the added accommodations by over two million in that same period, and it is estimated that fewer than 200,000 affordable units will be put in place this decade (JCHS, 2018).

C. Market Forces Affect Developer Attitudes

Two key drivers of multifamily housing starts have produced unfavorable conditions for low-income households: the cost of construction and availability of skilled labor. Scarcity in the construction labor market has driven up wages by 3.8 percent over the past year, nearly 1 percent in excess of the growth in total private sector wages. That number reaches 5 percent for workers in the residential construction industry (US Bureau of Labor Statistics, 2017). This predominantly affects housing starts of lower-priced units, which cannot absorb higher input costs without sacrificing margins.

Indeed, considering the rising costs of construction, the margins on lower priced units are already razor thin, if feasible at all.

Tariffs imposed by the new White House administration have affected housing prices, notably for steel and aluminum products essential to construction. Overall, the Producer Price Index (PPI) for inputs to new multifamily construction has risen by 6.6 percent since October 2017 compared with a rise in the Consumer Price Index by only 2.3 percent over the same period (Associated General Contractors of America, 2018). Fears of tariff-burdened soft wood lumber from Canada have been temporarily allayed in the wake of a new NAFTA agreement, however, builders continue citing material costs as their second highest concern (National Association of Home Builders, 2018).

The effect of unfavorable market conditions has negatively correlated with housing starts over the same period. The most recent joint report of the U.S. Census Bureau and HUD indicated that multifamily housing starts have declined by 4 percent year-over-year in October 2018, equating to 14,000 fewer units (US Census Bureau, 2018). More illuminating is the National Association of Homebuilders (NAHB) Multifamily Production Index (MPI) that indicates developer sentiments about the multifamily housing market. This index has witnessed an increase in low rent multifamily prospects of nine percent from Q3 2017, indicating renewed enthusiasm (NAHB, 2018). Affordable housing in America has come to a tipping point and the industry is ripe for disruption.

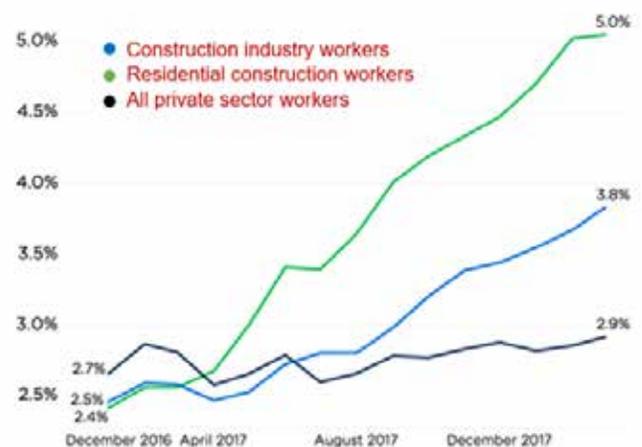


Figure 2. Year-Over-Year % Wage Growth (12-month moving average)
Source: US Bureau of Labor Statistics, 2018.

OPPORTUNITY

Savvy developers may soon capitalize on changes in affordable housing in the most troubled US markets thanks to innovations in design and production methods in modular construction. Recent improvements in manufacturing throughput and building material used in modular construction have reduced the cost-to-market with respect to both multi-family rentals and single-family home applications. Many factory-based modular firms operating on the West Coast claim the capability to deliver housing units at half the cost and in half the time as traditional site-built units. Whether these claims manifest themselves remains to be proven, however case studies show that modular construction reduces the construction schedule by 45 percent as the process is inherently insulated from budget variance (Smith & Rice, 2015).

A. Benefits of Modular Construction in Brief

Modular construction is distinguished from general off-site construction. The latter is performed in a climate-controlled factory environment and utilizes assembly line technology to construct building components for transportation to a construction site. These components vary from structural insulated panels (SIPs) to precast concrete. Modular construction, conversely, is the off-site construction of complete modules assembled together in the form of much larger buildings, i.e. townhouses, apartment complexes, and even high-rise offices. Historically, these modules have been used primarily as detached housing units, where they are assembled upon a permanent chassis and transported to prepared building sites. The first of these types of buildings were in use during World War I, as military “mobilization buildings.” The U.S. and British armies first issued standardized plans for temporary structures in 1914

designed to be assembled and dismantled efficiently during wartime (Garner, 1993).

Today, numerous modular building manufacturers exist around the globe, and the industry has benefitted from renewed interest from investors. Katerra is one such company. The firm has enjoyed a large capital influx from the venture capital firm SoftBank, allowing them to conduct the R&D necessary to improve U.S. construction productivity. Other modular building firms include Blokable in Washington state, and Guerdon Building Systems based in Boise, Idaho.

Productivity in construction has significantly lagged other industries in the past century. A recent report by McKinsey & Company found that productivity gains in construction have stagnated at around 6 percent since 1945, while gains in manufacturing, retail, and agriculture exceed 1500 percent in the same period. This is due to the fragmented nature of construction driving thin margins. Construction culture in the United States is informally operated, yet highly regulated, and thus knowledge management in this industry has been sporadic and undervalued (McKinsey & Company, 2017).

Realizing productivity gains of other industries is no small task. Construction is inherently a bespoke process, with each project entailing building-specific and site-specific requirements. Even in the face of these challenges, however, modular construction has proliferated in Asia and Europe where cost savings exceed 30 percent in modular projects (WSP, 2018). The qualitative benefits of modular construction are not only compelling, but quantifiable cost savings will also drive investor interest in modular building techniques, particularly for affordable housing scenarios.

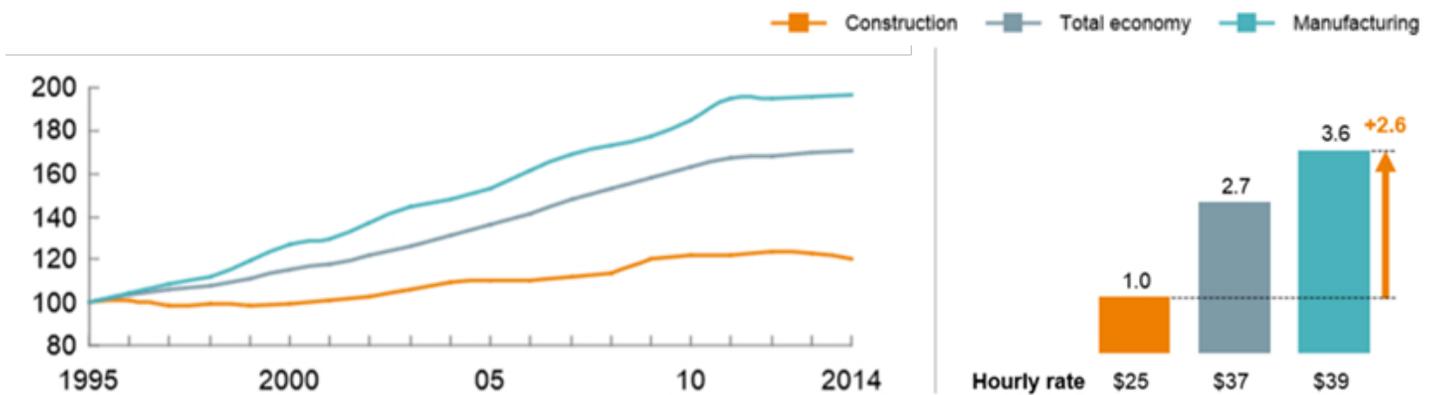


Figure 3. Labor productivity growth in construction industry versus manufacturing and total economic output. Source: McKinsey Global Institute Analysis, 2017. (Left): Real Gross value added per hour worked by persons engaged, 2005 \$ (Right): Compound annual growth rate, 1995-2014 (%) Index: 100 = 1995.

B. Drivers of Affordable Housing Starts

Affordable housing development is driven by similar factors as market rate housing, though with exceptions. One important component driving feasibility is the environment for public subsidy. In recent years, public assistance programs have trended towards disinvestment in affordable housing programs, though, as shown earlier, developers have shown increased optimism for affordable multifamily projects in the past year.

Much of this speculation stems from the risk profile of luxury condos and rentals. Units on the higher end of the price spectrum are locked in a costly positional arms race to provide incrementally better amenities and the best tenants, including costly concessions such as free rent, yet the average sizes of these rentals are static. As the standard of amenities and fixtures in market rate rentals is growing, low-income housing standards remain largely unchanged, with most qualifying families satisfied to have a safe and suitable home. More risk-averse investors can find consistent revenue streams and high occupancy rates in low-income multifamily investments. These types of investment vehicles are also insulated from volatility in the economy because they are exhaustively underwritten and much of the funding is backed by the U.S. government. While high-end luxury and market rate offerings have saturated many urban and suburban markets, a strong demand for workforce housing remains.

The fragmented nature of affordable housing funding sources is a primary impediment to projects getting off the ground. In many jurisdictions, applicable funding is plentiful, yet developers find the requisite approval processes to obtain incentives cumbersome. Inclusionary zoning policies also do little to encourage affordable housing supply and can even deter affordable development. For example, the cost of apportioning ten percent of a multi-family development as affordable may require additional floors to satisfy the requirement. Rather than shouldering this extra cost, developers often opt to build in other jurisdictions, or become discouraged from building (Bertolet, 2017).

Recently, efforts have been made to streamline review processes for affordable housing projects, particularly on the West Coast. For example, several permitting districts in Washington State have enacted provisions for expedited review in areas with high public demand. Some cities offer combined public hearings and designated liaisons to assist in navigating the process. Perhaps most relevant to modular

construction project is the concept of pre-approved designs. This type of policy has gained wide popularity with respect to single-family approvals, but has yet to gain traction on the East Coast. The process involves a jurisdiction pre-selecting architects to compile a library of approved plans, usually through a competitive bid process. Developers and builders then purchase the plans from catalogs with ease. This process, in conjunction with other measures, can facilitate affordable development across the country and should be applied in cost-burdened states.

MODULAR MULTIFAMILY IN MAINE: STRATEGIES FOR THE PINE TREE STATE

Consider Maine as an example. It is home to a population of 1.3 million, ranking it the 42nd most populous state as well as the least densely populated east of the Mississippi River (US Census Bureau, 2018). Still, most of the state's population is concentrated along its Atlantic Coast. Maine's population has been aging steadily in recent decades as the Baby Boomer demographic grows older. Among New England states, it has experienced a significant population shift towards retirement age. Maine, New Hampshire, and Vermont, have the oldest average age. Maine's average has risen from 38.6 in 2000 to 44.7 in 2017 (Colgan, 2006). Among several contributing factors is the "brain drain," in which young Mainers continue to move to more populous and higher paying markets.

Just as Maine's human capital flocks to major cities, its retirement population trends from seasonal visits from the Boston and New York towards year-round residency. Opposing migration patterns have increased Maine's elderly population and deteriorated its median annual income. As of 2017, Maine ranked 44th in the United States for median annual household income at \$50,856 per year: nearly 13.9 percent below the national median (US Census Bureau, 2017). Meanwhile, rental rates have increased over the



Figure 4. A modular multifamily rental project, Bethany, OR. Source: M.O. Stevens, 2016.

same period. In 2000, the median monthly rent was \$861, while in 2015 median rentals exceeded \$1600 (Maine State Housing Authority, 2017).

Many of the issues exacerbating rising rental rates can be attributed to the supply-side of housing. For instance, much of the housing stock in coastal communities has transitioned to short-term rentals. Maine exceeded the national average of seasonal housing stock by nearly twelve percent in 2006 (Pollakowski, 2009). Increasingly, housing located where fisherman and mid-coast employees work is being taken out of the year-round rental stock as they become more profitable as vacation rentals. Residents of these communities find themselves traveling longer distances to reach employment.

Long distance commuting costs severely impact Maine's affordability ranking (NLIHC, 2015). Case studies have shown that, due to the state's geography and infrastructure, the cost of commuting to primary employment areas puts units in otherwise affordably priced areas out of reach (Pollakowski, 2009). While developers have scaled back multifamily construction in Maine due to outmigration, renter households have *increased* in Maine by 6.6 percent since 2015, and 21.1 percent since 2000 (US Department of Housing and Urban Development, 2018). An increasing disconnect is evident between supply and demand, yet no market solution has been reached.

A. Role of the Public Sector

Adopting streamlined regulatory processes is one viable way for states like Maine to bring more units online. States should allow municipalities to enact pre-approved permits for certain housing projects deemed highly-desirable. These pre-approvals may also come with a package of common, streamlined requirements in order to obtain funding from the plethora of publicly available funds at minimal administrative effort and cost. States should also consider creating policies that prioritize subsidies and approvals for modular construction. Modular projects minimize unforeseen cost overruns and environmental concerns. For these reasons, they are more amenable to public-private partnership. Streamlining the site selection process would alleviate many of the bureaucratic and financial hurdles faced by developers. A common set of criteria for site selection allows a committee to preselect municipally owned lots, which could be earmarked for affordable housing development in the future through a competitive bidding process.

B. Side-by-Side Comparison

A side-by-side analysis of an affordable housing project was performed in 2010 by a housing developer in Maine. The study compared modular construction versus traditional site-built construction. Off-site construction allows the builder to pre-install much of the plumbing and wiring at a rate exponentially lower than the prevailing wage rate for skilled electricians, plumbers, and mechanical subcontractors.

What is most important, however, from the standpoint of feasibility and financing, is the bottom line. In this case, the two processes were comparable in price. In fact, the modular construction process came in almost \$60,000 higher than the traditional method, or 1.7 percent. Whether these costs reflect a fair markup on the true costs of modular construction versus the price that can be achieved in a competitive market remains to be explored, but for the sake of this study we will consider the hard cost advantage to be marginal.

The first important takeaway from the study is that it was compiled in an era of drastically different economic conditions. The year 2010 followed a severe recession, particularly for the homebuilding market. Today's macroeconomic environment reflects a nearly 180-degree difference. As reported previously, both construction wages and material costs have risen dramatically since 2015 to their prohibitively high 2019 levels. Extrapolating relevant data can increase the accuracy of the results of this study using the prevailing rates of today's economy, specifically in Maine.

The first important takeaway from this example is that it was compiled in an era of drastically different economic conditions. The year 2010 followed one of the most consequential recessions in modern history, particularly for the homebuilding market. Today's macroeconomic environment reflects a nearly 180-degree difference. As reported previously, both construction wages and materials costs have been on the rise dramatically since 2015 to prohibitively high levels today, in 2019.

We may get a more accurate reading of the results of this study by extrapolating the data using the prevailing rates of today's economy, specifically in Maine. According to the Maine Department of Labor, rough carpenters in Cumberland County, where the study was conducted, earn nearly 15.5 percent more in 2019 than in 2010 (\$19.92 versus \$17.25) (Maine Department of Labor, 2010, 2019).

When applying this generally to the labor portions of the study, and taking into account previous studies of the labor savings relative to modular construction (see WSP, 2018), the modular method would realize additional savings of roughly \$79,000. Likewise, construction materials have increased 25.2 percent from January 2010 to December 2019 according to the Producer Price Index (FRED, 2019). Considering the portion of materials used in construction relative to total hard costs and the waste reduction factor attributable to modular construction, a survey of 809 architects and engineers found that 44 percent reported a savings of at least five percent (Bernstein et al., 2011). Using a figure of five percent materials savings for such a project, there is potential for an additional cost savings of roughly \$20,000. The effect of time and market conditions indicates that today's environment may tip the scales in favor of a modular construction method by a margin of nearly \$50,000 – which does not include the qualitative benefits of greener building, more streamlined process, increased safety, and less variability due to external forces.

CONCLUSIONS

There are numerous of reasons to consider more research with respect to the use of modular construction, particularly with respect to multifamily applications in affordable housing development. In summary, the benefits of modular construction are as follows:

3. From a qualitative standpoint, modular construction has been shown to increase workplace safety, decrease the risk of unforeseen environmental risks to the project, promote the ease of assembly, and compress total construction schedule.
4. From a quantitative standpoint, modular construction has been shown to reduce hard and soft costs by 10-20 percent, decrease the number of change orders to fewer than six, reduce the construction schedule by up to 45 percent, and increase labor productivity by greater than 30 percent.

On the other hand, the modular construction industry has experienced significant barriers that have hampered its ability to capture market share, including:

5. Modular construction has a stigma associated with products brought to market immediately

following World War II. Modular construction is also often associated with mobile home communities, more commonly “trailer parks”, and are perceived as a lower quality product than site-built units. Ironically, modular construction is markedly more resilient due to its ability to be transported from factory to site.

6. Facilities which produce modules are static by nature and sparsely located. Particularly on the East Coast, there are few companies producing the types of modules which are sophisticated enough to meet the requirements of today's multifamily projects. Transportation of the modules is cost-prohibitive in rural states where the need is greatest.
7. Financial and governmental regulatory structures are not conducive to modular construction. There is a limited understanding of modular construction and underwriting standards in many jurisdictions. As more projects come online in the coming years with respect to multi-family applications, this will become less of an issue.

In the past decade, manufacturing technology, facilities and process design, and state-of-the-art construction materials have greatly improved the productivity of off-site construction. The trend of investment in research has been largely absent in the construction industry, though the impetus for change has been driven by the fall, and subsequent rebound, of the housing market following the 2007-2009 financial crisis. The latter half of this decade has seen construction wages, labor and materials prices increase the cost of development, giving many developers reason to seek cost-cutting and efficiency measures such as the ones realized by prefabrication.

Modular Construction is not yet suitable for all market segments but has shown a great deal of promise in addressing the critical shortage of low-income housing solutions. First, this method has the ability to bring more units onto the market much more quickly than traditional methods. Finally, it is an inherently predictable project, which may ultimately lead to more favorable underwriting standards and cheaper financing. These reasons make

modular construction an attractive option for addressing affordable housing needs in cost-burdened states like those in Northern New England.

Both the public and private sectors have an active role to play in adopting this method. Private developers must exhibit a newfound willingness to participate in building for this underserved population, but in order to do so, capital and regulatory environments must be competitive. The public sector can address these deficiencies by adopting measures that make the permitting process less onerous, such as cataloging preapproved designs, and taking an active role in site selection and acquisition. Only through a willingness to address these issues will policy enable construction performance to meet the goals of affordable housing.

WORKS CITED

- Associated General Contractors of America. (2018). *Producer Prices and Employment Costs*. Arlington, VA: Associated General Contractors of America (AGCA).
- Bernstein et al. (2011). *Prefabrication and Modularization - Increasing Productivity in the Construction Industry*. Bedford, MA: McGraw-Hill Construction.
- Bertolet, D. (2017). *Higher Prices, Fewer Affordable Homes?*. Seattle: Sightline Institute.
- Blumenthal, P., Handelman, E., & Tilsley, A. (2016). *How affordable housing gets built*. Washington, DC: Urban Institute.
- Colgan, C. S. (2006). *Maine's Aging Economy and the Economy of Aging*. Muskie School of Public Service (pp. 1-10). Portland: University of Southern Maine.
- Emmet, B. &. (1965). *Catalogues and counters: A history of Sears, Roebuck and Comp*. Chicago: Universtiy Press.
- FRED. (2019). *Producer Price Index by Commodity for Special Indexes: Construction Materials*. St. Louis: Federal Reserve Bank of St. Louis.
- Garner, J. S. (1993). *World War II Temporary Military Buildings: a brief history of the architecture and planning of cantonments and training stations in the United States*. Champaign, IL: US Army Corps of Engineers.
- Glaeser, E. L., & Gyourko, J. E. (2008). *Rethinking Federal Housing Policy: how to make housing plentiful and affordable*. Washington, DC: AEI Press.
- Joint Center for Housing Studies. (2018). *State of the Nation's Housing 2018*. Cambridge: Harvard Universtiy.
- Maine Department of Labor. (2010, 2019). *Prevailing Wage Rates, Cumberland County, B2*. Augusta: Maine Department of Labor.
- McKinsey & Company. (2017). *Reinventing Construction: a route to higher productivity*. Global: McKinsey Global Institute.
- National Association of Home Builders. (2018). *Multifamily Production Indices*. Washington, DC: National Association of Homebuilders.
- NLIHC. (2015). *A Brief Historical Overview of Affordable Rental Housing*. Washington, DC: National Low Income Housing Coalition.
- NLIHC. (2018). *Out of Reach 2018*. Washington, DC: National Low Income Housing Coalition.
- Plunz, R. (2016). *A History of Housing in New York City*. New York: Columbia University Press.
- Pollakowski, H. O. (2009). *Housing Affordability in Maine: Taking Stock*. Cambridge: MIT Center for Real Estate.
- Smith, R., & Rice, T. (2015, April). *Premanent Modular Construction: process, practice, performance*. Salt Lake City: Modular Building Institute.
- US Bureau of Labor Statistics. (2017). *Average weekly earnings of production and nonsupervisory employees, not seasonally adjusted*. Washington, DC: Bureau of Labor Statistics (BLS).
- US Census Bureau. (2017). *Current Population Survey; Annual Social and Economic Supplements*. Washington, DC: US Census Bureau.
- US Census Bureau. (2018). *Quick Facts: Maine*. Washington, DC: US Census Bureau.
- US Census Bureau and Department of Housing and Urban Development. (2018). *Quarterly Starts and Completions*. Washington, DC: US Census Bureau.
- US Department of Housing and Urban Development. (2018). *Comprehensive Housing Market Analysis: Portland-South Portland, Maine*. Washington, DC: HUDUser.gov.
- WSP. (2018). *Modular Construction for Multifamily Affordable Housing*. San Francisco, CA: WSP USA.