BENEFITS AND OPPORTUNITIES OF OFF-SITE CONSTRUCTION

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BACKGROUND

Buildings are significant contributors to global greenhouse gas emissions, prompting the need for more energy-efficient and zero-emission construction practices. Off-site construction, which involves the planning, design, and assembly of building elements in a factory environment and away from the final site, offers a solution to both the housing crisis and emission reduction efforts.

Benefits of Off-Site Construction

Enhanced Community Well-Being and Health

Off-site construction relocates 80% of construction activity to factory settings, accelerating timelines and minimizing disturbances for residents (Modular Building Institute 2023b). It reduces on-site noise, dust, and use of heavy machinery, improving sleep quality and reducing health concerns for nearby residents. A climate-controlled environment minimizes mold growth in materials, enhancing indoor air quality and lowering health risks. This approach is especially beneficial for dense urban areas, where it minimizes on-site disruption.

Addressing the Affordable Housing Crisis

With reduced construction time and costs, off-site construction can help address the affordable housing crisis. Modular and prefabricated building techniques allow for mass production and economies of scale, resulting in lower per-unit costs. Faster construction timelines bring housing to market quickly meeting the demand for affordable housing more effectively.

Waste Management

Off-site construction generates significantly less waste than traditional methods, with a potential reduction of 83% (Loizou et al. 2021). Advanced machinery and accurate cuts in factory environments contribute to this reduction.

Lower Carbon Emissions

Off-site construction reduces carbon emissions by 25% compared to traditional methods (Kouhirostami 2023). Centralized manufacturing in a factory setting minimizes transportation of material and workers, lowering fuel consumption and overall carbon emissions.

Enhanced Safety Measures

Off-site construction offers a safer working environment with better lighting, limited fall risks, less exposure to large construction vehicles moving around tight workspaces and, minimizing exposure to hazardous conditions such as extreme weather, uneven terrain. This makes it an appealing option for individuals with disabilities, such as those sensitive to extreme temperature or sunlight exposer, who may struggle in traditional construction settings.

Increased Efficiency and Cost Savings

Off-site construction projects can be completed 30-50% faster than traditional methods, plus digital design and optimization before assembly contributes to fewer change orders and better cost control from the outset (Modular Building Institute 2023a). For example, building a typical 2,000-square-foot house using modular methods can significantly reduce overall costs compared to stick-built methods (Fixr 2023).

Figure 1. Cost to build a 2,000-square-foot home, modular vs. stick-built, national average. Source: Fixr 2023.

When compared to traditional stick built, off site construction can achieve:

- 80% Construction Activities Conducted in Factory Settings
- 83% Reduction of Waste
- 25% Reduction of Carbon Emission
- 30-50% Faster Project Completion

Only about 3% of residential construction in the United States uses off-site construction

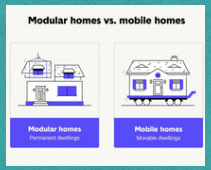
Source: Canva Images

Regions without standardized practices or statewide programs face difficulties as local officials cannot effectively inspect distant fabrication facilities. ICC/MBI Standards 1200 and 1205 and the ICC's Primer on Off-Site Construction help address these challenges by providing standardized solutions for regulatory and inspection processes.

Misconceptions and Challenges in Off-Site Construction

Misconception: Association with Manufactured and Mobile Homes

Many homebuyers mistakenly equate modular homes with manufactured and mobile homes, commonly referred to as "trailers." Manufactured homes are built to the HUD Code and have permanent chassis, while modular homes adhere to state and local building codes like traditional site-built homes. Unlike modular homes, manufactured homes face stricter zoning regulations that limit their size, design, and placement.



Source: The Zebra, 2024

Misconception: Lack of Customization

A prevalent misconception is that off-site constructed homes lack customization and come in standardized designs. In reality, off-site construction offers diverse and highly customizable options. Buyers can choose from various styles, layouts, and finishes, and architects can work with construction firms to create fully custom homes that meet individual preferences and architectural requirements.

Challenge: Confusing Regulations and Difficulties with Inspection Process

Off-site construction projects face unique challenges in ensuring compliance with building codes due to distant fabrication and sealed components delivered to site. Thirty nine states and Washington, D.C. require plan review and inspection of off-site construction components, however, these programs vary significantly state by state – some allow third-party agencies to conduct both plan review and factory inspections, while others only allow state employees to do so.

Standard 1200 provides requirements for designers, manufacturers, transporters and assemblers to assure that off-site construction components are produced under a quality assurance/quality control process and that they can demonstrate compliance with building code requirements.

Standard 1205 addresses the compliance verification process including permitting, in-plant and on-site final inspections, third-party inspections, as well as the role of Industrialized Building Departments, state modular programs and localities.

Standard 1210 addresses mechanical, electrical and plumbing system elements used in off-site construction with respect to energy efficiency, water conservation, planning, designing, fabricating, transporting, and assembly within commercial and residential buildings.

Source: Modular Home Builders Association

Source: ICC, NTA, Plan Review Inspection Jurisdictions, https://www.icc-nta.org/services/off-site-construction/jurisdictions-map/