Modular Housing:
Benefits, Challenges and Lessons Learned

Background

Modular housing is housing that is partially built in a plant, shipped to a development site, and placed on a foundation, where the roof structure and exterior finishes are completed. Working in partnership with the private and non-profit housing sector, BC Housing has become one of the largest housing developers in the province and is always on the lookout for innovative construction practices and new forms of housing. BC Housing and its partners began testing modular construction methods in 2006 and have used these in three affordable housing initiatives: Olympic Legacy Housing; Seniors' Rental Housing; and Independent Living BC.


Tumbleweed Terrace, Keremeos

To understand the benefits, challenges, and lessons learned from its experiences, BC Housing held a focus group with stakeholders who had worked on these modular housing construction projects. The group included representatives from the manufacturers, designers, non-profit housing providers, construction managers, developers, and BC Housing staff.

One of the key goals was to determine the ideal modular construction form, or the best way to layout and join individual modules. It is hoped that capturing this information will improve future outcomes in modular construction for affordable housing projects for both BC Housing and non-profit housing providers within B.C. and other jurisdictions as well.

Benefits and challenges

The literature on modular housing often states that it is more cost effective and time efficient compared to conventional "stick-built" housing construction. The focus group identified many benefits in using modular construction; however, all residential construction comes with some challenges. While the use of modular construction helps to overcome some of the difficulties associated with stick-built construction, the modular construction process has some unique challenges. The following table highlights potential benefits and challenges as identified by the stakeholders based on their experiences with the three housing programs.

POTENTIAL BENEFITS

Modular construction can be more time efficient.

- Stakeholders estimated modular construction took about half the time compared to stick-built construction (including pre-planning, plant assembly, onsite prep work and onsite assembly).
- The same design plan can be used for each unit reducing the time for the pre-planning phase and resulting in efficiencies on the assembly line.

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POTENTIAL BENEFITS *(continued)*

Modular construction can be more time efficient. *(continued)*

- Modular construction can take place at the same time as the onsite prep work or when the weather is not suitable for outdoor work.

Modular housing can be higher quality.

- Stakeholders said modular units often have better than average ratings on final inspections.
- Modules are built in a centralized location allowing for better supervision for quality control.
- Modules are built indoors protecting them from the elements during construction.
- Modules are built to be sturdy, as they must be transported by truck to the development site.
- Housing providers have reported few ongoing maintenance issues with modular units.

Modular construction can be more sustainable.

- Modules can be built to LEED energy-efficiency standards.
- Modular construction involves precise planning and purchasing of materials, so there is less waste.

Modular construction can be more cost effective.

- Improved time efficiencies can lead to lower carrying costs because the units can be occupied sooner.
- Improved quality of the modules can lead to reduced costs for ongoing maintenance.
- Improved sustainability of the construction process and modules can lead to cost savings through reduced waste and increased energy efficiency.
- Modular construction can save costs compared to bringing trades people to remote communities where skilled labour may not be available.

Modular construction can be more appealing for neighbours.

- Modular construction minimizes disruptions for neighbours due to more efficient timelines of onsite work.
- Perceptions about the aesthetic appeal of modular units have improved.

POTENTIAL CHALLENGES

Transporting modular units to the development site can have challenges.

- Units can be damaged during transportation.
- Transportation costs can be high when building in remote locations and units are transported over long distances, as plants are typically located in the southern part of the province.
- Cranes are expensive to transport to sites.

Integrating modules onsite can have challenges.

- Completion of the units may not match the timing of the onsite prep work, which could lead to damage to the units stored outside, or to extra storage costs.
- Connecting a unit's plumbing, mechanical and electrical systems onsite can be challenging, especially when using two-dimensional drawings and the units arrive with the walls already sealed with drywall.

It can be difficult to find trades to do onsite assembly of modular units.

- Some local tradespeople felt that the contracts for doing the onsite assembly of modular units were too small to bid on and they would rather bid on full construction projects.
- Some local trades were apprehensive about doing the onsite assembly, due to a lack of familiarity with modular housing.

POTENTIAL CHALLENGES *(continued)*

The modular housing industry lacks processes to ensure units are built to BC Building Code standards.

- The modular housing industry is CSA certified, which is recognized by the BC Building Code, but there are no building code standards specific to modular housing.
- CSA does not conduct BC Building Code inspections – the plants are inspected rather than the units.
- Units must meet municipal bylaws, which may differ depending on where the modular units are installed.

Standard unit design plans can lead to difficulties.

- Standard unit design plans do not take into account differing climates around the province, so modifications may be necessary to deal with extreme cold, heat, or moisture.
- Unit design plans must be examined carefully, as a mistake could affect many units when building large-scale projects using standard design plans.

Responsibility for handling call-backs for modular units can be ambiguous.

- It can be difficult to arrange repairs once modular units are transported to remote locations.
- It can be unclear whether the manufacturer or the onsite contractor is responsible for making repairs.

The modular industry may not yet be prepared to deal with large-scale projects in B.C.

- Stakeholders questioned the priority social housing projects would have among manufacturers when there is increasing demand for high-end modular units.

Lessons learned

Stakeholders identified the following lessons learned based on the challenges they experienced with using modular construction.

- Pre-planning and integration is essential in order to take advantage of the potential cost- and time-saving benefits of modular construction.
  - All stakeholders involved in a project should be consulted in the pre-planning stage, including the construction manager and onsite trade representatives.
  - Drawings developed in the pre-planning stage need to demonstrate how the plumbing, electrical, and mechanical connections will be implemented once the units are onsite (it was suggested that three-dimensional drawings or full models may be a better option than two-dimensional drawings).
- Modular construction should only be used when it offers clear advantages over conventional construction.
  - Climate issues and variations and the availability of trades should be factored in when considering modular construction.
  - Modular construction may be most beneficial when the same unit plan can be used for a large-scale project to save pre-planning costs.

The ideal modular construction form

Based on their experiences with BC Housing's modular projects, stakeholders were asked about the ideal form for multi-unit projects using this type of housing. They agreed it is important first to take the target client group into consideration, as the form may vary to meet different needs held by groups such as seniors and people with disabilities.

As trucks are required to transport modules to sites, a module's size is restricted to approximately 400 square feet. Once onsite, modules can be placed in various configurations to create larger units depending on the needs of the client group. Side-by-side configurations with an opening to create an 800-square-foot unit can be ideal for families, or staggered rows that create 600-square-feet L-shaped units can be suitable for seniors. Modules can be placed as single cottages; but, given the cost of land, they are typically configured into multi-unit projects, either as row housing or stacked into multi-storey buildings.

While stacked multi-unit projects can be the most cost-efficient use of modular construction, these projects can have challenges when it comes to connecting plumbing, electrical, and mechanical systems. According to stakeholders, designing these systems in recessed closets running down the corridor may be a good solution to addressing integration concerns. However, this would require the systems to back onto the unit and be connected by vertical shafts between storeys. This could affect the design of the unit, or may not even be possible due to BC Building Code requirements around distance to venting.

There are also many options for incorporating corridors when creating stacked multi-unit projects using modular construction, each with its own challenges. Stakeholders said options include integrating the corridor across the unfinished building plan, dropping modules lengthwise side-by-side about five feet apart and then putting in the corridor, designing a module to serve as a corridor rather than a unit, or running the corridor down the middle of the modules.

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