

# Modular Building

BC faces a growing housing supply and affordability gap. Communities are searching for solutions to accelerate the construction of new housing. Modular housing is a construction method that uses building modules that are built in-factory, then combined on-site. This method requires less on-site construction labour, which can speed up the construction process. The adoption of modular buildings is still relatively new in BC, and research on whether modular buildings are resilient to the effects of climate change is needed. However, the advantage of quick on-site construction provides several benefits for communities that experience short construction seasons and need quick and effective solutions to rebuild after extreme climate hazard events.

Modular homes are **flexible** options that can be built with **moisture** and **fire-resilient** materials.

However, **overheating** is a common concern, and building quality is highly **variable** based on the materials and design used.

Wildfire



Can be built with fire-resistant materials.

Rain and Floods



Can be built with moisture-resilient materials and/or constructed on a high foundation.

Windy



Performance depends on strength of connections.

Extreme temperatures



Heat loss and overheating depend on exterior insulation.

Seismic



Mixed seismic performance depending on design



# Climate Resilience

Component	Modular Building	Pit Houses
Fire	<p>✓ / ⚠ Short construction time can make it easier to avoid wildfires.</p> <p>Buildings can be made with fire-resilient materials.</p>	<p>✓ Naturally fire-resistant.</p> <p>Can be further fire-proofed with steel roofing.</p>
Floods	<p>✓ Raising the foundation and waterproofing can improve flood resilience. Some modular buildings can float or be moved out of flood zones, such as Rotterdam's Floating Pavilion.</p>	<p>⚠ Flooding can occur due to low structure (exact location of the house is important).</p>
Moisture	<p>⚠ Depending on materials used, buildings can be made to be more moisture resilient.</p> <p>Needs to be well ventilated to reduce buildup of moisture. Stagnant air can lead to mold growth.</p>	<p>⚠ Needs to be well ventilated to reduce buildup of moisture.</p> <p>Stagnant air can lead to mold growth.</p>
Extreme Temperatures	<p>! Many modular homes reported overheating. Following energy modeling guidelines can mitigate this risk.</p>	<p>✓ Great natural insulation and less heat loss from wind due to low structure.</p> <p>For low to medium cost, roof overhangs or insulation (reflective roofing) can be added.</p>
Wind	<p>⚠ Wind resilience requires composite panels and robust connections. Debris-impact and connection fatigue may be issues.</p>	<p>✓ Natural protection due to being underground, and less impact due to low structure.</p>
Seismic	<p>⚠ Seismic performance dependent on design, particularly the strength of connections.</p>	<p>⚠ Reinforcements needed through bracing or panels, such as wood or metal frames or tyre foundations (earth-filled tires) below the walls.</p>

## Benefits & Risks

Aspect	Benefit of Modular Construction	Risk of Modular Construction
<b>Environmental</b>	Reduced on-site construction means less material waste and fewer carbon emissions from labor force travel. Greater reuse and recycling of materials.	More research is needed on potential environmental risks.
<b>Durability</b>	Modules can be replaced and relocated during climate events.	Early iterations of modular buildings lacked durability.
<b>Energy Efficiency</b>	High energy efficiency.	
<b>Economic</b>	Up to 10% overall cost savings due to lower costs for materials, trades, and transportation.	A large investment is necessary for modular services. The front-loaded nature of construction can become a problem if there are delays or setbacks. Prefabricated units may be completed and ready but cannot be used or stored indefinitely. This can lead to additional costs for storing units.
<b>Social</b>	Improved on-site safety, high production quality due to controlled settings, adaptable in various contexts.	Lack of industry knowledge and awareness. Some of the most-used public procurement approaches can meet challenges when modules are not easily customizable for different needs and can incur costs.
<b>Regulation &amp; Codes</b>	The inclusion/reference of new codes and standards in the building code streamlines paths for prefabricated designs to be expected.	Limited awareness among industry regulators. Current prefab standards are treated as admin docs rather than part of the code, which means provinces may or may not enforce them.

# Technical Feasibility

## Materials:

Material requirements vary widely depending on the specific design of the modular building.



## Maintenance and Lifespan:

Modular homes are potentially more climate-resilient because rebuilding is more efficient and cost-effective. Shorter on-site construction time allows for the avoidance of natural disasters and is beneficial for places with short construction seasons. Modular homes can be relocated during climate hazards.



## Barrier: Building Codes

Modular buildings are not referenced in the building code.

- Prefab standards are treated as admin docs rather than in code, which means provinces may or may not enforce them.
- Modular builders must prove that the building is up to the standard of the building code. The Canadian Standards Association (CSA) has guidelines to streamline this process.
- Generally, modular components are inspected and approved in-factory, then delivered to sites in an envelope. There is usually no need for on-site inspections.

Guidance materials for both industry and municipalities can help address these challenges.

*CSA A277, Procedure for certification of prefabricated buildings, modules, and panels is a document that can be used to certify a manufacturer's products, if referenced in the building code.*



## Construction

Fewer on-site skills are needed to complete a modular home compared to traditional construction methods. Some work can be automated in factory environments. However, the lack of industry knowledge and awareness of modular building methods can be a barrier, as limited experience can lead to longer view and approval times.

Furthermore, procurement of modular units can be challenging if modules are not easily customisable for different needs. Less prescriptive designs and more collaborative procurement methods could make it easier for communities to acquire and use modular units.

Construction time varies. However, due to faster on-the-ground work, modular building can be 25-50% faster than conventional approaches.



## Examples of Modular House Construction

### Vancouver Coastal Health Staff Housing (Bella Bella, BC)

Constructed in 2015 to provide staff housing for Vancouver Coastal Health workers in Bella Bella, this modular construction project meets Passive House standards, which means that building uses minimal energy. Modular construction led to faster completion of the project (seven months) with minimal disruption to the quiet community.

Some of the challenges faced during this project included:

- Meeting Passive House standards, as the local construction team was new to this design approach. New enclosure details were needed. These specifications can be standardised for future projects.
- Bella Bella's wet conditions, which made completing air and water-sealing particularly challenging. The modules were protected on all six sides for shipping with a water-repellent but vapour-permeable sheathing membrane.
- Limited access to trades and materials on-site. Off-site construction addressed this barrier.

More information about the project is available in a [case study](#) from SFU Renewable Cities.

### Aqsarniit Hotel (Iqaluit, NU)

This hotel will be used for temporary residence and hotel guests. Modular construction was helpful because Iqaluit has a short construction season. Construction was started two years before the units were shipped to the site (by ocean) in the summer. Exterior insulation was installed in-site to ensure a continuous layer of insulation.

More information about the hotel is available from the [Modular Building Institute](#).



**Note Space:** *Community & Personal Knowledge*