CAML COHERT -8

AFFORDABLE MODULAR HOUSING DESIGN

JAN 12-26, 2026

Project Undertaken

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REPORT

CONTENTS

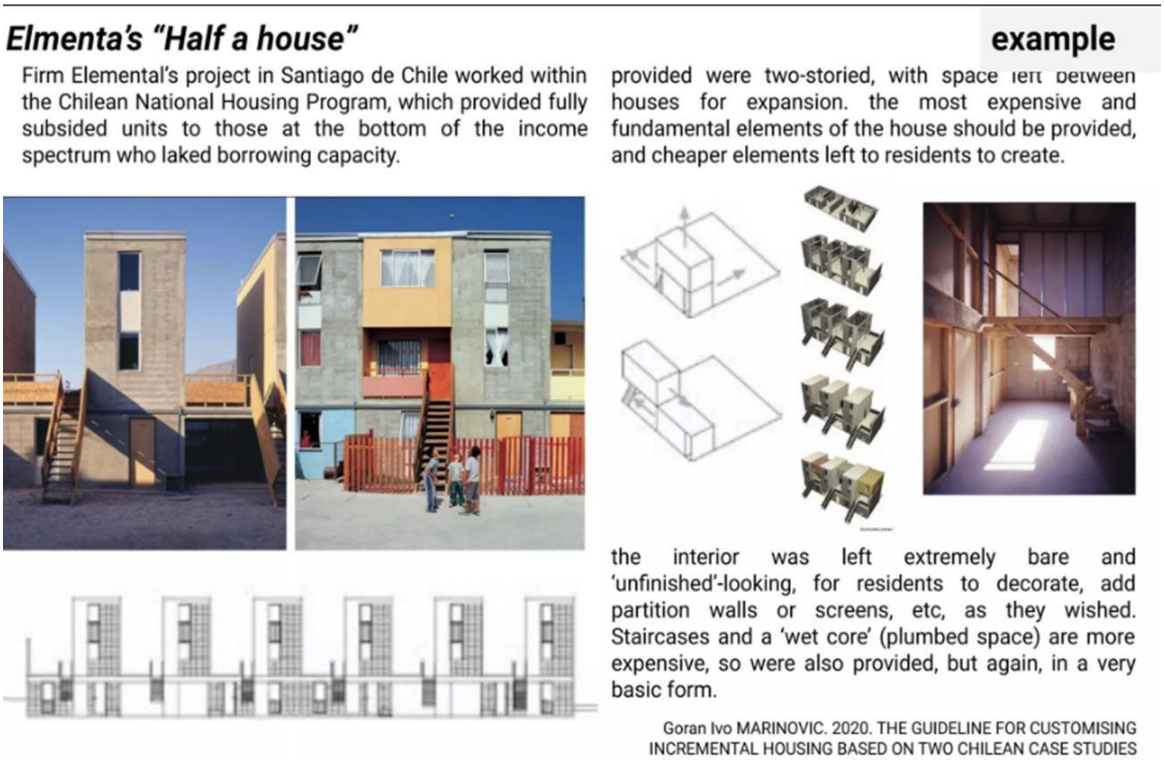
Overview:

This report provides a comprehensive analysis of modular construction as a strategic solution to Canada's housing affordability and supply challenges. It begins by framing the national housing crisis not merely as an issue of price but as a systemic failure of traditional construction methods, which are plagued by inefficiencies like sequential workflows, weather dependency, and design fragmentation. Modular housing, defined as the off-site factory fabrication of building modules assembled on a permanent foundation, is presented as a mature, high-quality alternative that directly addresses these flaws through controlled manufacturing, offering reduced timelines, waste, and labor variability.

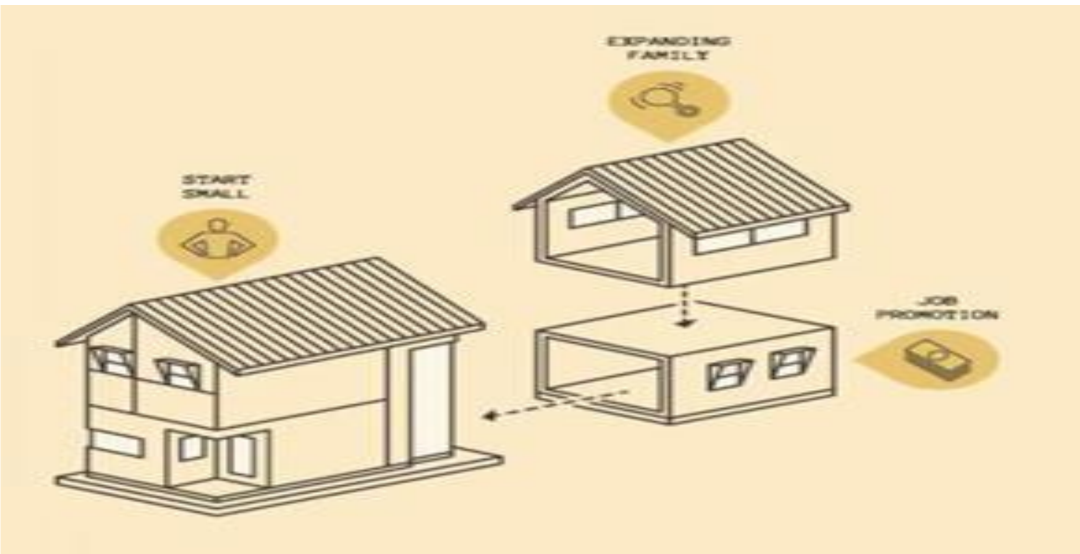
The document is structured around two principal modular design approaches, each targeting distinct market segments. The Single-Core Modular Housing model delivers a complete, ground-oriented starter home through a single, fully finished module designed for incremental horizontal expansion. It is positioned as an entry-point solution for low-income households (earning $30,000–$55,000 annually), emphasizing dramatically lower upfront costs, financial flexibility, and suitability for suburban or rural contexts. In contrast, the Multi-Core Modular Housing model is a hybrid system for medium-density developments, combining a permanent on-site core (for elevators, stairs) with attached factory-built apartment modules. This approach serves low-to-middle-income households ($55,000–$90,000 annually) by leveraging shared infrastructure and economies of scale to reduce per-unit costs, making it ideal for urban and peri-urban areas.

A significant portion of the report is dedicated to a detailed, comparative Cost Analysis. This analysis is bifurcated to examine both core-first single-family homes and multi-unit mid-rise buildings. It employs a bottom-up methodology, deconstructing costs for materials, labor, logistics, and soft costs, benchmarked against top-down regional averages. The findings are unequivocal: modular construction delivers substantial savings. For single-family homes, efficiencies in labor, schedule, and waste reduction contribute to overall cost savings of 35–45%. For a standardized 40-unit, 3–4 storey building, modular methods achieve a consistent ~15% reduction in total capital costs compared to conventional construction in both British Columbia and Alberta, translating to savings of $900,000 and $800,000, respectively.

The report further explores critical enabling factors and constraints, including material selection for hybrid systems (addressing fire safety and energy codes in provinces like Alberta), the regulatory and permitting landscape across Canadian municipalities, and the inherent risks related to supply chain volatility and logistics. By synthesizing technical cost data with market-focused design strategies, this overview establishes modular construction not as a niche product but as a scalable, practical toolkit for delivering affordable, accessible, and quality housing across Canada's diverse regional and demographic spectrum.



Elemental – Incremental Housing / "Half a House" (Quinta Monroy Housing Project)(9)
Architect: Alejandro Aravena / location: Iquique & Santiago, Chile 2003-2004

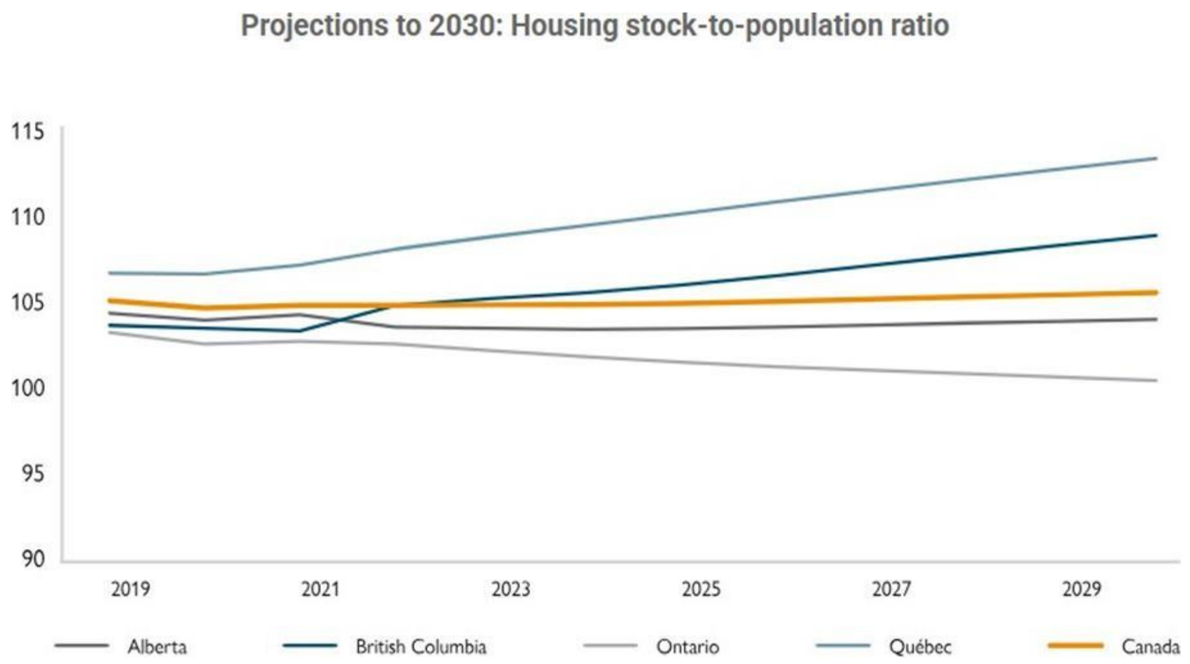


Modular House Grows With Its Owners (10)

Introduction:

Canada’s housing crisis—affecting families, young adults, seniors, newcomers, and people with disabilities—is typically discussed in terms of rising prices and homelessness [1]. However, a critical truth is that all housing forms, including single-core and apartment-core housing, must be both affordable and accessible to serve the entire population. This crisis stems from systemic inefficiencies in traditional construction, not just material costs. Key drivers include fragmented on-site trades working sequentially, weather-dependent schedules, one-off designs requiring repeated approvals, high labor intensity for systems work, and financing costs inflated by long timelines [2]. Modular housing, a method where prefabricated modules are built in a factory and assembled on-site, emerged in the 20th century to address such inefficiencies [3]. Having evolved from a post-war expedient into a sophisticated alternative, it now offers comparable quality and durability while providing a direct response to these systemic flaws through controlled manufacturing, which reduces timelines, weather delays, and labor variability [4].

Crucially, accessible housing is not a special category for a small group but a foundational requirement for inclusive communities. Well-designed accessible homes benefit everyone across life stages, including parents with strollers, injured workers, and seniors aging in place, aligning with the principles of Universal Design [5]. Modular construction is uniquely positioned to deliver on this promise of affordability and accessibility at scale, as standardization allows for the efficient integration of universal design principles from the outset [6]. Modern advancements have equipped it with high-quality materials, energy-efficient systems, and increased design flexibility [4]. However, for modular housing to fulfill its potential as a widespread solution, significant challenges remain. Beyond the need for greater public acceptance to overcome lingering stigma, regulatory and zoning barriers must be updated [7]. Furthermore, the industry must pursue further reductions in production costs, increased use of sustainable materials, and improved design adaptability for diverse climates and cultural contexts [8]. Addressing these issues is essential to transform modular housing from a viable alternative into a core driver of a more affordable and universally accessible housing system.



Source: CMHC calculations based on CMHC and Statistics Canada data [1].

Background:

Modular housing is a building system composed of pre-manufactured units, or modules, constructed off-site in a factory-controlled environment before being transported and assembled on-site, complying with the same building codes and standards as conventional construction but differing fundamentally in its production methodology [3]. Its core parts include structural modules made of steel or engineered timber framing, along with prefabricated floor, wall, and roof panels; Mechanical, Electrical, and Plumbing (MEP) systems are typically pre-installed within these modules, which are then integrated on a permanent foundation and connected using specialized bolts, joints, and seals [4]. Constructed from materials selected for durability, cost-efficiency, and sustainability—such as insulated panels with mineral wool or rigid foam, exterior cladding like fiber cement, and energy- efficient components including double-glazed windows—this method ensures consistent quality and reduced waste through controlled manufacturing [6].

Historically, modular housing began as basic temporary shelter but has evolved substantially, embracing modern design, advanced materials, and sustainable practices; the integration of digital tools like Building Information Modeling (BIM) has enhanced precision, enabling modular construction to now deliver permanent, scalable, and environmentally responsible housing solutions for residences and multi-story developments alike [2].

The principles of modular construction offer a scalable solution for housing, ranging from standalone residences to dense urban developments. This scalable methodology provides a crucial pathway for developers, directly addressing the spectrum of needs within Canada's housing crisis. Let's divide the solution into two different approaches:

Single-core modular housing approach

At the smaller scale, the single-core modular housing system exemplifies streamlined efficiency, delivering a complete single-family home through a single, fully finished module containing all essential living spaces and MEP systems that is installed on a permanent foundation.

In details, single-core modular single housing is a ground-oriented, single-family home model. It begins with a small but fully functional and complete core unit. This core is factory-built (modular), allowing for rapid on-site installation. Crucially, the design is intentionally planned for incremental, horizontal expansion by the homeowner over time.

The initial core module is a complete, livable space that includes all essential infrastructure and systems:

- A full bathroom (toilet, sink, and shower)
- A kitchen or kitchen wet wall
- Electrical panel and wiring
- Plumbing and drainage systems
- Mechanical systems (e.g., HRV, heat pump, or furnace)
- The load-bearing structure
- Full insulation and a finished building envelope
- All required fire and life-safety compliance features

The Modular Construction Process:

The core unit is constructed off-site in a controlled factory environment. This method delivers significant advantages:

- **Controlled Quality:** Precision manufacturing in stable conditions.
- **Faster Timeline:** Parallel construction (factory and site work) drastically reduces the overall schedule.
- **Predictable Cost:** Reduced risk of weather delays and on-site inefficiencies leads to more accurate budgeting.
- **Minimal Site Disruption:** On-site work is limited primarily to foundation pouring and module installation.

Source: Construction Process PowerPoint Template

Single-core modular housing stands as one of the most promising models for delivering affordable, flexible, and accessible ground-oriented homes. However, its success depends on three critical enablers: supportive zoning regulations, tailored financing products, and precise, forward-looking design from the project's inception.

Key Advantages (Pros)

- **Lower Up-Front Cost:** Building only the essential core first results in a smaller mortgage and down payment, creating a much easier entry point into homeownership.
- **Fast Delivery:** Installation takes days, not months. Factory construction happens concurrently with site preparation, leading to significantly faster occupancy than traditional building.
- **High Quality & Consistency:** Indoor, controlled factory conditions ensure fewer weather-related defects and consistent construction quality.
- **Expandable Over Time (Incremental Growth):** The home can grow with a family's size, income, and needs, offering long-term flexibility.
- **Financial Flexibility:** Costs are spread across years, allowing expansion when finances permit and reducing the risk of initial over-borrowing.
- **Excellent for Accessibility & Aging in Place:** The model easily accommodates a step-free entry, single-level living, and a fully accessible core bathroom.

Key Challenges (Cons)

- **Requires Available Land:** The model needs a private lot or land with ground access.
- **Zoning & Bylaw Barriers:** Municipal regulations can pose significant hurdles, including restrictions on small starter home footprints, prohibitions on future incremental expansion, and limits on adding secondary suites.

- Source: Example of single housing; Case study (Villa Verde Housing)


Multi-core modular housing approach

Multi-core modular housing is a hybrid system designed for mid- to high-rise apartment buildings, combining a permanent, on-site central core—constructed from concrete or steel to house elevators, stairs, and fire systems—with factory-built residential modules. The process begins with the construction and inspection of the structural core, focusing on life-safety and integrity approvals. Simultaneously, modular apartment units are manufactured off-site in a controlled environment, ensuring high quality and avoiding weather delays. Once transported, the prefabricated modules are lifted by crane, secured to the core, and connected via standardized “plug-and-play” utility interfaces. This approach merges the speed and precision of factory production with the structural flexibility of traditional core construction, accelerating final inspections and enabling faster occupancy compared to conventional high-rise methods [3,4].

Multi-core modular housing offers significant advantages, primarily faster project completion and higher quality due to parallel off-site manufacturing and on-site core construction. It reduces on-site disruption, improves cost predictability, and is highly efficient for repetitive designs like apartment towers. However, it requires extensive upfront planning and coordination, offers less design flexibility for customization, and faces logistical challenges in transporting large modules and securing crane access in dense urban sites. Additionally, navigating less familiar financing and regulatory pathways can pose initial hurdles for developers.

In August 2014, the Modular Building Institute recognized the Broadway Stack in Manhattan as its "Building of the Month." Designed by New York's Gluck+ and fabricated by Deluxe Building Systems of Pennsylvania, this seven-story modular apartment complex was one of Manhattan's first of its kind, representing a step toward more affordable urban housing. The project adopted modular construction to drastically reduce both timeline and cost, shortening construction by approximately half and lowering the budget by nearly 20%. Because the modules were manufactured off-site with interiors—including cabinetry, fixtures, and MEP systems—largely pre-installed, on-site work was streamlined to primarily connecting the delivered units.

Source: : Modular Building Institute / #Affordable #Housing

Research and finding:

Typical Unit Sizes & Building Types

Modular housing projects vary in size depending on use (individual homes vs multi-unit buildings):

- **Unit Size Examples**

  - **Single dwelling units / tiny homes:** Can be under 30–40 m² (~300–430 ft²) for compact/affordable designs if livability standards are demonstrated. Larger units (1–2 bedrooms) are typically **32.5 m² (350 ft²) and above**.

  - **Temporary/supportive modular units:** minimum 23.2 m² (~250 ft²) if livability is proven; standard dwelling units usually **37 m² (~400 ft²)** minimum.

  - **Multi-unit modular buildings:** Modules can be stacked side-by-side and vertically to form buildings containing dozens of units (e.g., 3-4 storied buildings with multiple studios or apartment units).

Modular projects (e.g., affordable housing initiatives) often use a base module designed for efficiency and repeatability and then combine them for larger complexes.

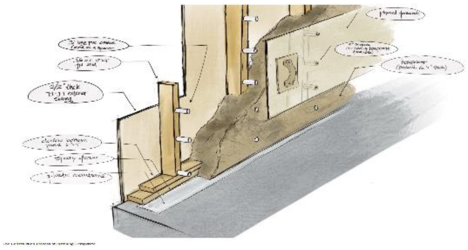
Materials & Parts for Modular Housing

Structural Materials

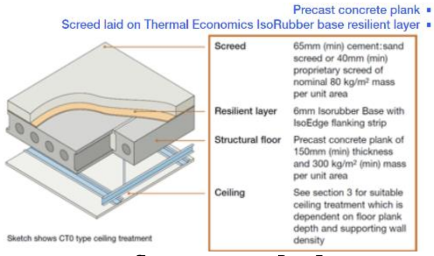
- **Wood framing:** A common choice for small- to medium-scale modular homes due to its cost-efficiency, ease of manipulation, good insulation properties, and lower embodied carbon.

- **Steel framing:** Used for taller or more complex multi-unit modules; it’s strong, durable, and recyclable, which benefits larger modular buildings (e.g., 3+ storied).

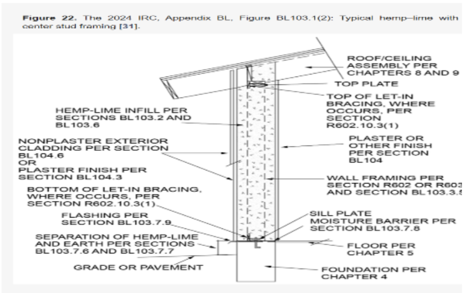
- **Concrete for foundations or load-bearing elements:** Provides stability, especially where soil conditions or frost protection is needed.



Hempcrete Wall System[11]

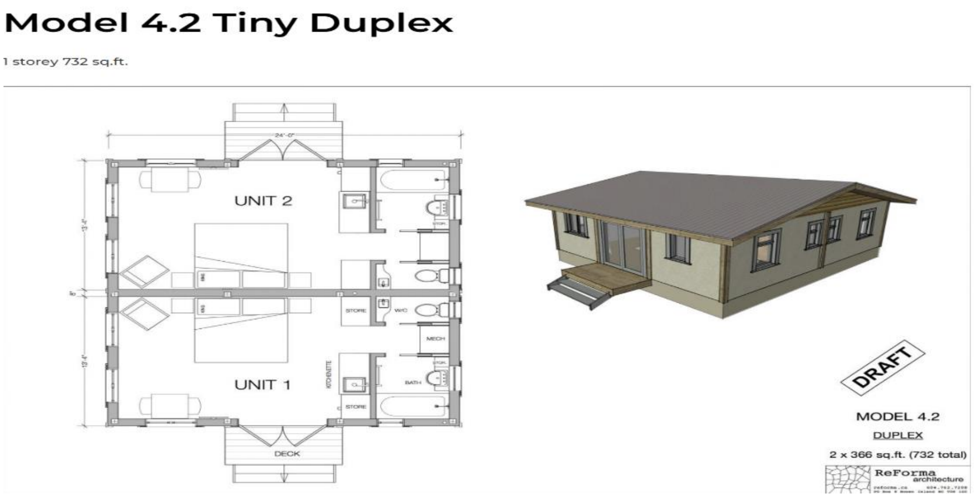


Concrete floor system[12]



Wall Structure[13]

Hempcrete Product Passes Fire Resistance Testing [14]



Tiny Row House[15]

Building Element	Selected Material	Fire rating	Why chosen
Structure	Concrete/Steel	2-4 Hr	Non-combustible
walls	Hempcrete	2-3 Hr	Fire-safe insulation
Floors	Concrete slap	2 Hr	Fire + Sound
Roof Shape	Gable (4:12)		Snow Safety
Roof Material	Metal+Hempcrete or Mineral wool	1-2 Hr	Fire & durability
Interior	Type X drywall	1-2 Hr	Code compliance

Fire-resistance ratings are based on National Building Code of Canada provisions[16]

Why these materials?

- **Factory quality control:** Pre-cut/engineered materials reduce waste and site labor and increase predictability.
- **Energy efficiency:** High-performance walls with rigid insulation panels (e.g., polyurethane or polyiso) create continuous thermal barriers to improve energy performance.
- **Sustainability:** Recycled or sustainably sourced materials (e.g., 80% recycled steel) help reduce environmental impact.

Parts & Systems

Common components in modular construction:

- **Factory-built wall, floor, and roof panels:** Preassembled for speed and quality.
- **Mechanical / electrical / plumbing (MEP) pre-installed:** Reduces field work and ensures uniform quality; centralized high-efficiency ventilation systems are recommended.
- **High efficiency fixtures & appliances:** ENERGY STAR® rated components reduce energy and utility costs over life of building.

➢ ***Why use these parts?***
Cost predictability & quality: Controlled factory conditions reduce waste and defects while increasing construction speed and affordability.

- **Energy savings:** Efficient insulation and mechanical systems reduce long-term operating costs.

Province's authorities, Permits and Regulations:

- **Authorities:**

- *Ontario government modular house checklist/city initiatives* — explains modular construction processes, inspections, energy & safety code considerations.
- *Calgary manufactured buildings guide* — overview of modular and prefab definitions and permit requirement basics.
- *Toronto Modular Housing Initiative* — example of how cities are using modular to expand affordable housing.
- *BC Housing and modular prefabricated housing PDF* — guidance on materials, sustainability & design approaches.
- *BC Housing Design Guidelines* — construction standards for affordable housing projects.
- *Modular Construction Materials primer* — outlines wood, steel, concrete options and their benefits.

- **City Permits & Regulations**
  - **Building Permits & Codes (Canada Context)**

    National/Regional Codes
    - Modular housing must comply with the local building code, typically based on the National Building Code of Canada, which provinces adopt into their own codes.
    - In Ontario, modules must be CSA A277 certified for factory manufacturing before on-site assembly to assure compliance with safety and building standards.

- **Municipal Permits & Zoning**
    - Before construction, confirm **zoning bylaws**: minimum lot size, setbacks, height limits, and uses permitted (e.g., residential, multi-unit).
    - **Building permits** required for structural, electrical, plumbing/sanitary, and mechanical compliance — even when modules are factory-built.
    - Some cities may have specific guidelines for **temporary vs permanent modular housing**, e.g., Temporary Modular Housing Design Guidelines in Vancouver specifying unit sizes, outdoor spaces, accessibility, and design context.
    - Early consultation with a planning/building department is key to avoid delays and get clear direction on local interpretations of codes and zoning.

- **Other municipal considerations**
    - Site servicing (water, sewer, power) must be planned and approved.
    - Landscape and integration into existing neighborhood context may be required by city planners.

Example: Alberta's housing scenario

- Alberta's housing market faces three major challenges at the same time: affordability, fire safety, and extreme climate conditions. Long, cold winters, increasing wildfire risk, and stricter insurance and permitting requirements mean that building materials must perform well under both fire exposure and freeze–thaw cycles, while still remaining cost-effective.
- The Alberta Building Code (ABC), which is based on the National Building Code of Canada (NBC), places strong emphasis on:
    - Fire resistance ratings (30, 60, 90, or 120 minutes)
    - Non-combustible construction for multi-unit and mid-rise buildings
    - Energy efficiency for cold climates
    - Proven, test-based materials that can be engineered and inspected
- Because no single material can meet all requirements alone, hybrid construction systems are the most practical solution in Alberta. These systems combine a structural material (wood, steel, or concrete) with non-combustible insulation or infill and fire- rated finishes to meet code and affordability goals.
- Fire Safety
    - Multi-unit residential buildings typically require 1–2-hour fire-rated wall and floor assemblies.
    - Fire performance is based on tested assemblies, not just materials.
- Energy & Durability
    - Walls must meet Alberta Energy Code thermal performance
    - Moisture
    - Air leakage
    - Freeze–thaw damage
- Structural Rules
    - Only engineered materials may carry loads
    - Alternative materials (e.g., hempcrete) are allowed only as non-structural infill or insulation

Cost Analysis:

This section provides a detailed cost analysis structured into two primary comparisons. The first section will describe the cost dynamics of **core-first modular housing** in direct comparison to traditional, site-built single-family housing of equivalent size and specification. Following this, the subsequent section will focus on the economics of **multi-unit modular construction**, analyzing a 3–4 storey residential building and comparing it to a conventional mid-rise building of identical scale and program.

Section 1: Core-first modular housing

This cost analysis provides a direct comparison between core-first modular housing and traditional, site-built single-family housing, assuming equivalent size, specifications, and adherence to building codes. Utilizing an industrialized construction and project management perspective, the evaluation focuses on key practical cost drivers, including materials, labor, logistics, supply chain efficiency, permitting, and construction time.

Table 1 – Core Structural Materials & System Comparison (BC & Alberta Context)

Material / System	Fire Safety Performance	Relative Cost	Code Acceptance (BC &AB)	Why This Material Is Used (Practical Logic)
Concrete (cores, floors, foundations)	2–4 hr fire rating	High	Fully accepted	Used where fire resistance, durability, and life-safety are critical; reduces future retrofits and inspection risk
Steel (modular frames, mid- rise)	1–2 hr with protection	Medium	Fully accepted	Enables fast, precise modular assembly and vertical scalability
Engineered wood (low-rise)	1–2 hr with protection	Low	Fully accepted	Lowest-cost structural option; widely understood by local trades
Hempcrete / mineral wool (infill)	Non-combustible	Medium	Allowed as non-structural	Improves fire safety and thermal performance without increasing structural cost

As highlighted in the table 1 above, it shows that for the Alberta housing scenario, no single construction material can independently satisfy all requirements for fire safety, energy efficiency, durability, and affordability. Both Alberta and British Columbia building codes prioritize the performance of tested assemblies over that of individual materials, a principle that inherently favors the use of hybrid systems. These systems strategically combine engineered structural materials for load-bearing capacity with non-combustible insulation and fire-rated finishes. From a manufacturing and cost-control standpoint, this integrated approach delivers significant benefits: it avoids costly post-construction fire retrofits, reduces uncertainty during the approval and inspection phases, and ensures high-cost materials are used only where they provide clear value. Ultimately, this strategy controls the risk-driven costs that are a major contributor to budget overruns in Canadian housing projects [1].

Table 2 – Cost Effectiveness Comparison: Traditional Single family Vs Core-first modular housing.

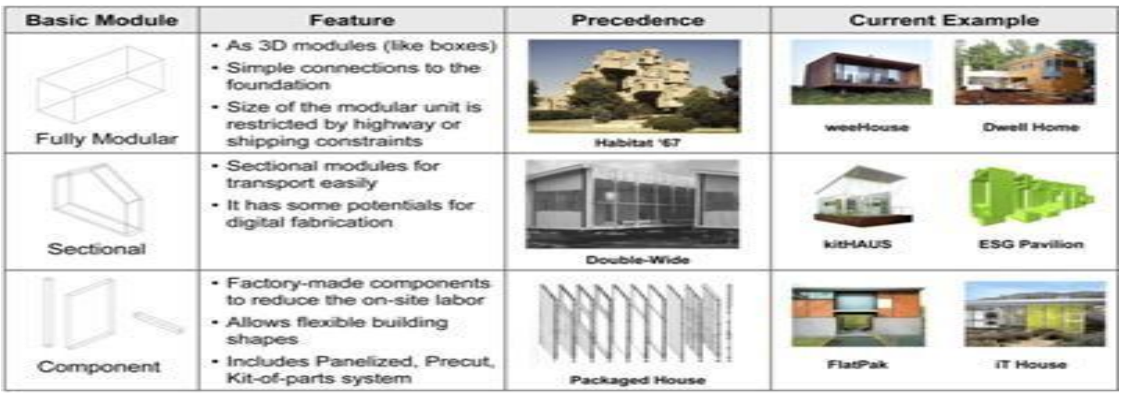
Cost Driver	Traditional Single Housing	Core-First Modular Housing	Typical Impact	Why the % Is Realistic
Labor	On-site, sequential trades	Factory labor + small site crew	**25–40% ↓**	Factory work removes weather delays, idle time, and rework
Construction Time	6–9 months	1–3 months	**40–60% ↓**	Site prep and building occur in parallel
Material Waste	~10–15%	<5%	**5–10% ↓**	Controlled cutting and standardized assemblies
Logistics	Fragmented deliveries	Consolidated module transport	**10–15% ↓**	Fewer handling events and site disruptions
Supply Chain	One-off purchasing	Repeatable bulk procurement	Unit cost ↓ at scale	Learning curve and volume effects
Permits & Inspections	Multiple site inspections	Factory certification + limited site checks	Soft cost ↓	Standardized, tested assemblies
Overall Cost	Baseline (100%)	~55–65%	**35–45% ↓**	Combined effect of all efficiencies

Off-site modular construction offers substantial efficiencies that address the primary cost drivers in Canadian housing. By shifting labor to a controlled factory environment, it can reduce labor hours by an estimated 25–40% through task specialization and repeatable processes. Perhaps the most significant advantage is a 40–60% reduction in the project schedule, as on-site foundation work and factory module fabrication occur in parallel, drastically cutting financing costs and weather-related delays. Additionally, factory precision reduces material waste to a more manageable 5–10%, minimizing both cost and environmental impact.

When these individual efficiencies are combined, they contribute to an overall cost reduction potential of 35–45%. Critically, these savings target the core affordability constraints identified in Canadian housing—time, labor, and soft costs—rather than just material prices.

Beyond modularization, the core-first model further enhances financial feasibility. This phased strategy minimizes initial capital requirements and risk by constructing only the essential, code-compliant core in the first phase. This improves delivery certainty and allows for future expansion as needed, transforming affordability into a managed, long-term strategy rather than a single, high-stakes investment

Start Small. Grow Smart. Own Your Home[17]



Basic Module	Feature	Precedence	Current Example
Fully Modular	• As 3D modules (like boxes) • Simple connections to the foundation • Size of the modular unit is restricted by highway or shipping constraints	Habitat '67	weeHouse, Dwell Home
Sectional	• Sectional modules for transport easily • It has some potentials for digital fabrication	Double-Wide	kitHAUS, ESG Pavilion
Component	• Factory-made components to reduce the on-site labor • Allows flexible building shapes • Includes Panelized, Precut, Kit-of-parts system	Packaged House	FlatPak, iT House

System Types by Basic Modular Element[18]

Section 2: Multi-unit modular housing

This section evaluates the cost analysis of a 3–4 storey multi-unit modular building, constructed with factory-built volumetric modules containing compact 350–430 ft² units, against a conventional on-site mid-rise building of identical scale and gross floor area.

The defined building program consists of 4 storeys with 10 units per floor, yielding a total net area of 16,000 ft² based on a 400 ft² average unit size. A 25% uplift for common elements results in a gross floor area (GFA) of 20,000 ft². All financial figures are presented in 2025–2026 Canadian dollars.

The methodology employs a bottom-up approach, calculating costs by deconstructing per-square-foot expenses for materials, labor, logistics, and soft costs, then scaling by the total GFA. These figures are validated with a top-down review to ensure consistency with prevailing mid-rise construction cost ranges in Canada.

Cost Estimation Methods and Assumptions

- Estimation Approach

A combined method is used: a bottom-up calculation of all direct, soft, logistics, and assembly costs is benchmarked against top-down regional averages for mid-rise apartments. The model assumes modular construction reduces core hard costs by 15–20% compared to on-site building, with some savings offset by logistics, craning, and a higher contingency.

- Key Assumptions

  The analysis is based on a 3–4 storey, 40-unit building with a 400 ft² average unit size. After applying a 25% circulation factor, the total gross floor area (GFA) is 20,000 ft².

The baseline costs per ft² (GFA) are:

Conventional: $300 in BC; $260 in Alberta.

Modular (reflecting a 15% core cost reduction): $255 in BC; $220 in Alberta.

All costs are in 2025–2026 Canadian dollars. Costs are categorized as:

Direct: Materials, labour, trades, and transport.

Indirect: Overheads and management.

Fixed: Design, engineering, and certain permits.

Variable: Costs scaling with area (e.g., materials, direct labor).

Capital (CapEx): Total one-time project delivery costs.

Risk/Contingency: Allowances for escalation and delays.

Module System

The analysis uses wood-frame volumetric modules, a common and suitable system for 3–4 storey residential buildings in both provinces. While panelized or steel systems are viable alternatives, they are not numerically modelled here.

Table 3 – Per-ft² cost structure (BC and Alberta)

Province	Delivery type	Total cost/ft² (GFA)	Direct hard costs (materials, labor, subs)	Soft costs (design, permits, fees)	Logistics & site (foundations, landscaping, craning)	Contingency allowance
BC	Conventional	$300/ft²	80% → $240/ft²	10% → $30/ft²	5% → $15/ft²	5% → $15/ft²
BC	Modular volumetric	$255/ft²	75% → $190/ft²	10% → $25/ft²	7% → $18/ft²	8% → $22/ft²
Alberta	Conventional	$260/ft²	80% → $208/ft²	10% → $26/ft²	5% → $13/ft²	5% → $13/ft²
Alberta	Modular volumetric	$220/ft²	75% → $165/ft²	10% → $22/ft²	7% → $15/ft²	8% → $18/ft²

The table shows that modular construction reduces direct hard costs while increasing the share allocated to logistics and contingency. In BC, total cost drops from $300/ft² to $255/ft², and in Alberta from $260/ft² to $220/ft², primarily due to factory efficiencies and more predictable production.

- **Total Project Cost for 3–4-Storey Building**

Table 4 – Total construction cost (20,000 ft² GFA)

Province	Delivery type	Cost/ft²	Total construction cost (20,000 ft²)
BC	Conventional	$300/ft²	$6,000,000
BC	Modular volumetric	$255/ft²	$5,100,000
Alberta	Conventional	$260/ft²	$5,200,000
Alberta	Modular volumetric	$220/ft²	$4,400,000

The data illustrate two key findings:

- **Modular construction is consistently more cost-effective.** In both provinces, the modular method has a lower per-square-foot cost, resulting in significant total project savings of 15% or more.
- **Regional cost differences exist.** Construction in Alberta is less expensive than in British Columbia for both delivery types, but the proportional savings achieved by using modular construction are similar in both markets.

➢ **Work Package Breakdown (BC Modular Case)**

Table 5 – BC modular 3–4-storey building (20,000 ft², $5.1M)

Work package	**Example inclusions**	**Approx. share**	**Approx. cost**
Factory module fabrication	Structure, envelope, interior finishes, in-plant MEP rough-in	55%	$2,805,000
Site works and foundations	Excavation, foundations, slabs, site services, landscaping	12%	$612,000
Transport and craning	Trucking, escorts, crane set-up and operations	6%	$306,000
On-site assembly and connections	Module stitching, final MEP, firestopping, testing	10%	$510,000
Soft costs (design, permits, approvals)	Architect, engineers, permits, inspections	10%	$510,000
Contingency and risk allowance	Escalation, minor scope changes, schedule risk	7%	$357,000

The majority of value is captured by factory fabrication, reflecting the modular strategy, but site works, logistics, and soft costs remain significant. The contingency line acknowledges residual uncertainty in prices, labor availability, and approvals.

An example of 40-unit modular housing illustration:

The total cost for the 40-unit BC modular building is $5.1 million; this equates to approximately $127,500 per individual 400 ft² unit. This results in a cost of about $319 per net square foot, a higher figure than the gross cost, as it accounts for the non-rentable space used for building services and circulation. Economically, the modular approach provides a clear advantage, reducing total capital costs by approximately 15% ($900,000 in BC, $800,000 in Alberta) compared to conventional construction, which directly improves project viability and creates budgetary room for enhanced building features.

The method is not without risks, remaining sensitive to material prices, labour costs, logistics, and approval processes. However, a sensitivity analysis indicates that a ±10% fluctuation in direct costs would still keep modular construction cost-competitive with conventional building in most scenarios. For 3–4 storey projects, this cost structure supports faster, more predictable delivery and consistent quality by encouraging standardized designs optimized for factory production. In conclusion, the findings suggest that volumetric modular construction can be a practical and financially viable strategy for delivering compact, affordable housing at scale in BC and Alberta, particularly when supported by complementary land-use and permitting policies.

Crane Installation of Volumetric Modular Units (On-Site Assembly)[19]

Comparison:

Housing Affordability Vs Income

Addressing Canada's housing affordability crisis requires innovative solutions that deliver cost savings without compromising quality or livability. This report analyzes two distinct modular housing designs—Single-Core and Multi-Core—developed to serve different segments of the market. By leveraging the inherent efficiencies of factory-built construction, both models offer significant financial advantages over conventional building methods. The analysis focuses on their respective target income groups, construction cost profiles, and their broader implications for mortgage and rental affordability, demonstrating how modular construction can be strategically deployed to alleviate housing pressures across diverse Canadian communities.

The two designs serve complementary yet distinct affordability purposes. Single-Core Modular Housing targets low-income households earning $30,000–$55,000 annually, offering an entry point into homeownership. Multi-Core Modular Housing serves low- to middle-income households in the $55,000–$90,000 range, providing density-efficient solutions for grouped developments. The financial structures differ fundamentally: the Single-Core model relies on incremental ownership and a minimized initial investment, while the multi-core model achieves savings through shared infrastructure and economies of scale in multi-unit configurations.

Single-Core Modular Housing: Affordable Entry-Level Ownership

This model is engineered for maximum accessibility. By constructing a compact, fully code-compliant core unit first, the upfront capital required is drastically reduced, with estimated unit costs between $100,000 and $150,000. This represents a 35–50% saving compared to conventional construction. Prefabrication is key to these savings, reducing labor, waste, and construction timelines by 30–50% through controlled factory production.

For the target low-income household, the impact is transformative. The smaller mortgage principal and reduced down payment help keep housing costs well within the Canada Mortgage and Housing Corporation's (CMHC) recommended benchmark of spending no more than 30% of gross income on shelter. Crucially, the design allows for phased expansion. Homeowners can add modules or finish additional space as their financial situation improves, distributing costs over time and mitigating risk. This model is ideally suited for entry-level homeownership in suburban or rural areas where lower land costs, such as in regions like Greater Victoria/Langford, further enhance feasibility.

Multi-Core Modular Housing: Density-Efficient Affordability

Designed for clustered developments like townhouses or urban-edge projects, the multi-core model spreads costs across multiple dwellings. By sharing core infrastructure—such as utilities, structural components, and transportation systems—and standardizing module designs, it achieves an estimated 25–35% per-unit cost reduction. These economies of scale lower the individual unit cost to a range of $180,000–$300,000, making medium-density housing more accessible.

This approach directly benefits low- to middle-income families and first-time buyers, enabling lower individual mortgage payments or rental rates while supporting the development density needed in constrained urban markets like those in British Columbia. The model aligns with federal initiatives aimed at rapidly increasing housing supply, as standardized factory production allows for faster project delivery than conventional low-rise construction, effectively turning capital savings into accelerated housing starts.

Key Affordability Takeaways:

The analysis reveals that both modular strategies provide powerful, targeted affordability tools. The Single-Core model minimizes financial barriers to homeownership, offering a low-risk, flexible path for the lowest-income groups, particularly in suburban and rural contexts. Conversely, the multi-core model balances affordability with density, efficiently lowering per-unit costs in grouped developments to meet the needs of urban and peri-urban markets.

Conclusion:

In conclusion, this report demonstrates that modular construction is a financially viable and strategically essential component in addressing Canada's multifaceted housing crisis. The comparative analysis reveals that both Single-Core and Multi-Core modular housing models offer significant, defensible cost advantages over traditional site-built methods. The Single-Core approach achieves profound affordability for low-income households by minimizing the initial capital barrier and enabling incremental, risk-managed homeownership. Simultaneously, the multi-core model effectively delivers density-efficient affordability for low-to-middle-income groups by capitalizing on the economies of scale inherent in factory production and shared infrastructure.

The core financial findings are compelling. Modular construction systematically attacks the primary cost drivers in Canadian housing—time, labor, and soft costs—rather than just material prices. The quantified savings of 35–45% for core-first homes and approximately 15% for multi-unit buildings provide a clear economic rationale for developers, policymakers, and financiers to adopt these methods. These savings directly translate into lower mortgage principals, reduced rental rates, and improved project viability, creating crucial budgetary headroom for enhanced building performance, sustainability, and universal design features that benefit all residents.

However, realizing this potential at scale requires concerted action beyond the factory floor. The success of modular housing is contingent upon modernizing supportive ecosystems. This includes updating municipal zoning bylaws to permit small footprints and incremental expansion, developing tailored financing products that recognize the unique risk and cash-flow profile of modular projects, and streamlining provincial and local approval processes to accept factory certifications. Furthermore, the industry must continue to innovate in sustainable materials, design adaptability, and logistical planning to mitigate remaining risks related to supply chains and urban assembly.

Ultimately, Single-Core and Multi-Core modular housing are not competing concepts but complementary instruments within a broader housing strategy. One unlocks ground-oriented ownership for individuals and families in lower-density areas, while the other accelerates the supply of dignified, cost-effective housing in density-seeking urban markets. Together, they present a scalable, equitable, and practical pathway to closing Canada's housing supply gap. By embracing modular construction and implementing the necessary regulatory and financial enablers, Canada can transform its housing system to be more affordable, accessible, and resilient for current and future generations.

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