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Why Modular Construction?

Presentation by Hank Starno
President - *MHI Canada*
National Trade Assoc. for Modular Building Manufacturers

Presentation Outline

What is Modular-Built Construction?

The term ***modular-built*** describes a method of constructing buildings to a very high degree of completion in climate controlled factories, for delivery & on-site completion at the building site where they will be occupied

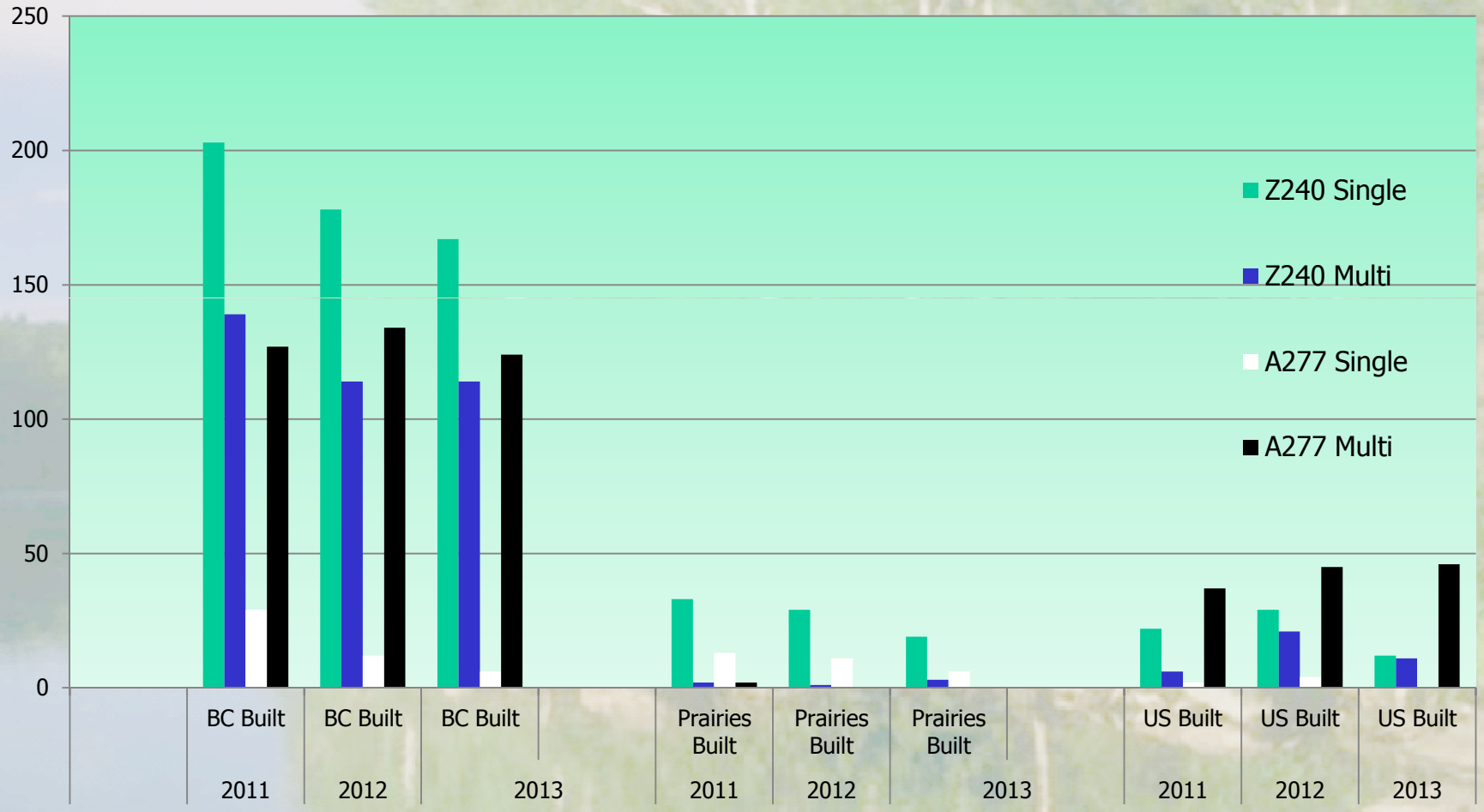
The term ***rtm-built*** also describes a method of constructing buildings to a very high degree of completion off-site, and usually outdoors, for delivery & completion at the building site where they will be occupied

The term ***site-built*** describes a method of constructing buildings from start to completion at the site where they will be occupied

None of the above terms describe a type of building

All 3 describe alternative construction methods

Breakdown of CSA Z240 and A277 Shipments from BC, Prairies and US based Manufacturers 2011-2013



Modular-Built Construction Defined

- The term **modular** describes a method of constructing homes or other buildings in one or more large sections.
- The type of home/building constructed is determined by the building code and design criteria that dictates the structure type.
- Homes described as bungalows, town-homes, duplex's and 2 - 6 storey multi-family housing can all be modular-built.
- A variety of commercial, industrial and other structures in the one to six storey range can be modular-built, and in some cases in combination with site-built construction methods.

Modular-built homes *for British Columbia are produced in full compliance with Part 9 of the BC Building Code, and certified compliant under the provisions of the CSA A277 Standard. Currently only CSA, Intertek and QAI have the accreditation required to certify factory compliance to the CSA A277 Standard.*

Building Codes in British Columbia

Modular-Built Homes – BC adopts the Model National Building Code of Canada (NBCC), to which some changes are made & provisions deemed appropriate are added. Many Modular-Built homes & other buildings are produced in BC, and like their site-built alternatives' must comply in all respects to the BCBC.

Manufactured Homes (mobile homes) – BC also adopts the CSA Z240 National Standard for manufactured homes. These homes are the most affordable single detached dwellings available in Canada and are very attractive to young families of modest means and the whole economic spectrum of retirees who seek care free living.

Advance Notice of Building Code Changes

*For the **traditional site-built home industry** adoption of building code related changes without advance notice does not create a problem.*

The reason is construction of those homes cannot commence until a 'building permit' has been issued, and the building code requirements in effect on the date of permit issuance are the requirements that must be met. The latter ensures traditional builders have significant time between the date they obtain a building permit and commence construction to familiarize themselves with code changes and construct the home accordingly.

*For the **modular-built & mfg. home industries** adoption of building code related changes without advance can be a disaster*

The reason is these homes are usually produced weeks, months and sometimes a year or more prior to issuance of a building permit. For that reason, the codes to which they comply can only be those in effect at the time the production process commences on each housing/building unit, unless the industry has at least 60 day advanced notice. ***With that 60 day notice the industry can ensure all homes produced are fully current code compliant when exiting the production line.***

How Modular-built Houses are Produced

- Typically in 40,000 to 100,000 SF factories on assembly lines at an annualized rate of 10 to 50 homes per month. Specialized steel framing tables are utilized to ensure all framing components are square and true

- Material storage and assembly take place within this controlled environment which ensures no moisture is built into the homes. Combined with absolutely square & true framing components, a level of fit, finish & building envelope performance/durability is achieved that very hard to match for construction that takes place on a home site

- In BC module widths of 14' to 20' and lengths of 40' to 76' are common. Roof pitch ranges from 2.5" in 12" to 6" in 12", with roof eaves up to 18"

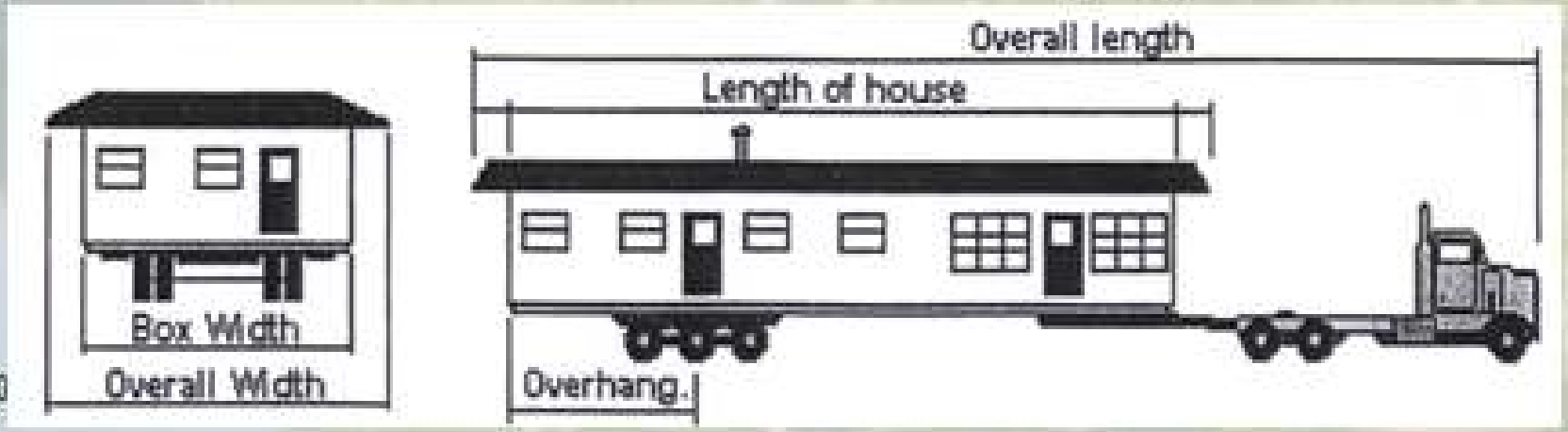
- With the arrival of 20' wide homes in some areas of BC yielding up to 1,520 GSF in a single module, many buyers find their housing needs can be fully met with one of these attractive & very affordable single module homes

- The above described factory production benefits mean the '*environmental foot print* of these homes is measurably reduced. The way they are produced & site assembled allows for easy floor plan reconfiguration to meet changing future occupant needs, and even allows for disassembly & relocation when circumstances dictate. The latter attributes make modular-built homes a highly '*sustainable*' housing option

How Modular Homes are Transported

- MB regulation governing the transport of these homes is dated and incomplete. But the 3 prairie provinces have long worked together in a harmonious way to facilitate transportation. In practice, both SK & MB generally follow the well researched and time-proven regulations developed by Alberta. Harmonization of the 3 provinces regulations is well underway & strongly supported by the MHAPP

- Current regulations generally allow modules of 14' or less to be transported on independent axles and wheels which most US based operations use, and tridem dolly system and low-boy style trailers which most Canadian operations use. In most cases these narrow modules do not require escort vehicles. Modules in excess of 14' in width must generally utilize a 12 or 16 wheel tridem dolly system, or a low-boy style trailer, with one or more escort vehicles



Modular-Built Homes - Foundation Options

Modular homes are designed to be placed on basements and other perimeter foundation system options compliant with Section 9.15. of the BCBC.

Alternatively, Modular homes may incorporate longitudinal frame rails under each section, in which case they have been designed to be placed on permanent foundation systems compliant with the CSA Z240.10.1 Foundation Standard. Foundations compliant with this Standard are acceptable under 9.15.1.3. of the BCBC for use under all housing that meets ***deformation resistance*** criteria contained in the Z240.2.1 Standard

9.14.6.2. Drainage away from Wells or Septic Disposal Beds

1) Surface drainage shall be directed away from the location of a water supply well or septic tank disposal bed.

9.14.6.3. Window Wells

1) Every window well shall be drained to the footing level or other suitable location.

9.14.6.4. Catch Basin

1) Where runoff water from a driveway is likely to accumulate or enter a garage, a catch basin shall be installed to provide adequate drainage.

9.14.6.5. Downspouts

1) Downspouts shall conform to Article 9.26.18.2.

Section 9.15. Footings and Foundations

9.15.1. Application

9.15.1.1. General

(See Appendix A and A-9.4.4.6. and 9.15.1.1. in Appendix A.)

1) Except as provided in Articles 9.15.1.2. and 9.15.1.3., this Section applies to
- a) concrete or unit masonry *foundation* walls and concrete footings not subject to surcharge
  - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
  - ii) for *buildings* of wood-frame or masonry construction,
- b) wood-frame *foundation* walls and wood or concrete footings not subject to surcharge
  - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
  - ii) for *buildings* of wood-frame construction, and
- c) flat insulating concrete form *foundation* walls and concrete footings not subject to surcharge (see A-9.15.1.1.(1)(c) and 9.20.1.1.(1)(b) in Appendix A)
  - i) on stable *soils* with an allowable bearing pressure of 75 kPa or greater, and
  - ii) for *buildings* of light-frame or flat insulating concrete form construction that are not more than 2 *storeys* in *building height*, with a maximum floor to floor height of 3 m, and containing only a single *dwelling unit*.

2) *Foundations* for applications other than as described in Sentence (1) shall be designed in accordance with Section 9.4.

9.15.1.2. Permafrost

1) *Buildings* erected on permafrost shall have *foundations* designed by a *designer* competent in this field in accordance with the appropriate requirements of Part 4.

9.15.1.3. Foundations for Deformation-Resistant Buildings

1) Where the superstructure of a detached *building* conforms to the requirements of the deformation resistance test in Z240.2.1, "Structural Requirements for Manufactured Homes," the *foundation* shall be constructed in conformance with
- a) the remainder of this Section, or
- b) CSA Z240.10.1, "Site Preparation, Foundation, and Anchorage of Manufactured Homes."

Assembly & Turn-key Completion at Home Site

- In most cases modular-built homes are installed and completed at the home site by a local builder or modular home retailer who purchases a home from a factory and sells it to a home buyer on a turn-key (ready to occupy) basis.
- The module(s) is/are either craned or rolled onto a basement or perimeter grade beam foundation, or positioned in an elevated position over footings on which piles will be placed and leveled. The module(s) are then lowered & secured to the piles
- If more than one, the modules are then fastened together at the 'marriage walls' and required exterior and interior work is completed. While this is going on all utility are connected. The modules as delivered from the producer have been inspected & Certified MBC compliant by CSA/Intertek/QAI, but all work completed at the home site must be inspected & accepted by local inspectors
- The home builder or retailer who sold the home then conducts the final inspection with the home buyer, closes the financial transaction, and hands over the keys.

MHI - Model Architectural Compatibility Guidelines

ADDRESSING DESIGN, CHARACTER AND APPEARANCE OF HOMES

1) Applicable to A277 Labelled Modular-built Homes, 20' or more in width, placed in urban, suburban and rural residential communities;

2) Height of the main floor above grade shall be consistent with the height of the main floor of other homes in the area;

3) Roof pitch, style, and features such as gables/dormers shall be consistent with, or complimentary to the roofs of other homes in the area;

4) Roof overhang/eaves/eaves troughs shall be a minimum of 30 cm from surface of each side wall;

5) Finishing materials used on roof & exterior walls shall be consistent with the materials used on other homes in the area;

6) Design of each modular-built home shall ensure the wall facing the street on which the home fronts contains a prominently placed 'front door and windows in quantity and size that are consistent with other homes in the area;

7) Modular-built homes may utilize basement or other perimeter foundations compliant with NBCC provisions contained in 9.15. Alternatively, deformation resistant modular-built homes designed to be supported on longitudinal floor beams and set on piling foundations with skirted perimeter enclosures can comply with provisions contained in NBCC 9.15.1.3; Full perimeter foundations, and skirted enclosures utilized on other basement alternatives, shall be parged to create a finish similar in appearance to that customarily found on basements of other homes in the area

Inspirational Modular-built Housing Examples

Affordable Single-Module Homes

Typical 2 & 3 - Module Homes

Typical Multi-Family Housing

Typical Modular-built Home Interiors

MODULAR CONSTRUCTION

MODULAR-BUILT HOUSING & OTHER BUILDINGS are INHERENTLY GREEN & SUSTAINABLE

Green & Sustainable Considerations

For this presentation today the following definition is being applied to the 'green' & 'sustainable' attributes of modular housing/ buildings

US EPA Definition of Green Building

Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.

Green-washing Opportunism

'Green Building – Definition' - approx. 114 thousand responses to Google search

'Sustainable Building – Definition' - approx. 5.4 million responses to Google search

GREEN MODULAR-BUILT HOMES/BUILDINGS

Smart Modular Design = Beauty, Cost-Effectiveness & functionality

Better Energy Performance – Climate controlled factory conditions and assembly line production procedures optimize framing precision and insulation/air barrier installation, resulting in a tighter and more energy efficient building envelope that requires less energy to heat & cool.

Reduced Environmental Footprint on Home-site – Homes/buildings arrive at destination in one or more large modules 85% + complete. On-site construction activity and timeframe is reduced by 70% or more, as are pollutants such as toxic heating fuels, chemical adhesives, asphalt waste materials, and construction impact on the home-site and neighboring property environment

Reduced Environmental footprint on the Greater Area – The consolidation of labour and most building materials at a housing/building factory, usually within 150 KM of the building site, results in substantially reduced car/truck traffic, noise, pollution, and quality of life impacts in general areas where construction of new homes and other buildings occurs.

Reduced material waste & improved disposal/recycling – Factories buy large quantities of lumber and other building materials, much of which is ordered to exact fitment requirements, thereby reducing waste. Waste that does occur is 50-70% less than when a building is constructed on site and is readily recycled or disposed of properly.

SUSTAINABLE MODULAR-BUILT BUILDINGS

Smart Design = Beauty, Cost-Effectiveness & functionality

Improved long term performance & durability – Climate controlled factory production ensures framing materials, sheathing, floor & roof decking are all installed dry and remain dry. This ensures moisture is not built into a structure during construction and that reduces potential for mould formation and moisture related performance and durability degradation.

Reconfiguration made easy - Modular homes/buildings usually carry total roof loads on the exterior walls of each module. This means most interior walls are not load bearing and can be easily removed or repositioned at any time to accommodate changing space needs which occur as children leave home and adults age, and for many other reasons.

Relocation & re-use made easy – Modular buildings comprise one or more modules that are constructed to near completion in a factory and then trucked to a destination for assembly and occupation. Subsequent disassembly, relocation and re-assembly is simply the reverse of how the building began life. Immediately following the 2010 BC Olympics 320 modular apartment style units put in place in Whistler to house 640 Olympian athletes were disassembled, relocated and reassembled in 6 small BC communities to house the elderly and others with special needs.

Environmental cost of building and then destroying functionally obsolete buildings is enormous – A systematic shift to the flexibility offered by modularized buildings for schools, day care, strip malls, housing and a number of other buildings that typically have time or function limited application could be a boom for sustainability gains in future buildings

MORE REASONS TO MODULAR-BUILD

- **Reduced construction cost & much shorter construction timeframe compared to site building**
- **Short construction timeframe means reduced interim financing and insurance costs**
- **Efficient factory design & mechanization improves productivity and reduces labour costs**
- **Steel framing jigs used to ensure square and true modular structures**
- **Fully fire protected modules can yield measurably lower 'course of construction' insurance costs related to increasing numbers of *'framing stage fires'***
- **On site worker numbers & time on site are reduced, as is elevated work requirements, resulting in fewer injuries and further reduced 'course of construction' insurance costs**
- **Fewer sub-trades and associated coordination problems**
- **Severe weather conditions have no impact on housing production**
- **Climate controlled working conditions and material storage improve product quality**
- **Certification to CSA Building Standards means no building inspection of modules on site**
- **Homes leave factory fully secured against theft & vandalism at the home site**

Winter Games. 2010 Olympic Legacy Affordable Housing Program:

Initial Use: Whistler Village Temporary Accommodations.
Single-storey modules, each containing 3 to 4bedrooms, hotel style, were combined and assembled to house officials during the 2010 Olympic games.

Modular Systems

Pre-fabrication can be taken to yet another level, that of whole systems, thereby maximizing the benefits of a controlled environment, such as better quality control measures for environmental separations and improved construction detailing. These systems are pre-fabricated entirely off-site and delivered as completed *modular* units. These units will define the architectural character of a building and can be combined into any configuration. Modular systems were perfected in the housing industry but now the non-residential sector is benefiting from the expertise that was developed.
By their very nature, modular systems lend themselves to phased construction. Units come complete with rough wiring and plumbing installations, plus the outside walls bear all the loads so the interior spaces are ultimately flexible. Each unit can be self-sustaining and construction can proceed in stages.

Second Use: Permanent Social Housing Facilities (Surrey Social Housing)

Single-storey modules were disassembled and relocated following the Olympic Games to six BC communities where they were reconfigured to form six different housing projects, from 1 to 4 storeys in height.

Photos: WEQ Britco LP

BC Winter Games. 2010 Olympic Legacy Affordable Housing Program:

•Another benefit is the ability to reconfigure the units for change of use at a future date.

•An example of this is the temporary accommodations provided for athletes, officials and team representatives at the 2010 Olympic Winter Games in Whistler, BC
Modular systems are particularly suited to short timelines or to areas where labour is difficult to find. In remote communities where the delivery of materials is a challenge and labourers are at a premium, time and ease of erection are of utmost importance. In the far north, foundations can be built during the summer season and modular units brought in once the ice roads are operational. Very little time is needed on-site; once the foundations are in place, the modular units are simply installed, electrical and plumbing services are hooked up and finishing can commence; quick installation and finishing means quicker occupancy.

Initial Use: Whistler

Discussion and Questions