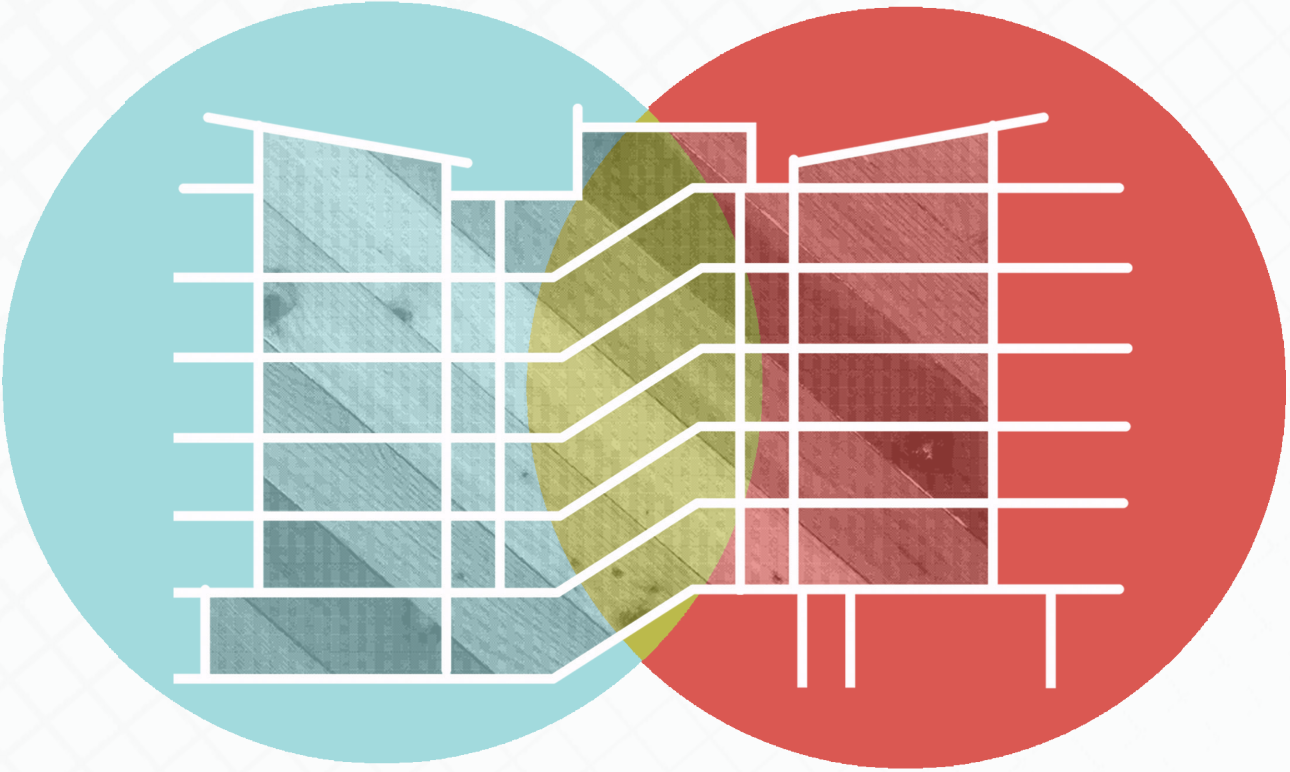

WOOD FOR MID-RISE CONSTRUCTION

Opportunities for Atlantic Canadian Urban Centres

UPLAND
Urban Planning + Design Studio

March 2017

Prepared for Atlantic Wood*WORKS!*

Prepared by UPLAND

Acknowledgments

Atlantic WoodWORKS! is a project of the Maritime Lumber Bureau.

Atlantic WoodWORKS! is a non-profit program that partners with governments and industry to expand the use of regionally produced wood products in non-residential and multi-family construction markets by providing technical support, promotional services and hosting educational events.

The project is supported by:

Canada

Canadian Wood Council / Conseil canadien du bois

New Brunswick / Nouveau Brunswick Canada

Newfoundland Labrador

Nova Scotia

For more information and to learn how our program can assist you visit:
www.atlanticwoodworks.ca

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UPLAND

Turner Drake & Partners
TriCity Contracting
BMR Engineering
QS Online Cost Consultants

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1 Introduction

1.1 About this Report

Recent changes to the National Building Code of Canada (NBC), and a trend towards more diversified housing options, have meant that many Canadian jurisdictions are acting quickly to capture the environmental, economic and social benefits of higher wood buildings. The 2015 NBC now permits wood frame construction to be 6 storeys high. Today, already 75% of Canadians live in jurisdictions that allow 6 storey wood frame construction.

With the overall benefits of using wood as a building material well documented, Atlantic WoodWORKS! studied the opportunities for 6 storey wood construction in Atlantic Canadian Centres. The research included a comprehensive market study and projections for mid-rise demand in four major centres in Atlantic Canada, a review of recent and upcoming planning changes in major Atlantic Canadian cities and a full cost analysis, comparing wood construction to three other construction methods in use in the Atlantic market using a real-life wood mid-rise structure built by an experienced builder.

1.2 Wood as a Building Material

History

The history of human habitation is closely tied to wood. Neolithic Europeans constructed timber houses by splitting logs and embedding them vertically into the ground. The traditional log cabin has a very long history in the mountainous regions of Europe and North America. Parts of the Jokhang Monastery in Tibet, thought to be the oldest surviving timber frame building in the world, were constructed as early as 639 AD. The Faroe Islands are home to what may be the oldest surviving inhabited wood building in the world (constructed in the eleventh century AD), despite lacking any forest of their own. Even for buildings constructed of stone or masonry, wood often played an essential role as structural components, formwork, scaffolding, and finishing details.

In North America, abundant forest resources have made wood a particularly attractive option for construction. Various First Nations peoples used wood as a vital component of their architecture; the Mi’kmaq wigwam, the Iroquois longhouse, and the plains tipi are some examples. European settlers continued this trend, harvesting the wood resource to construct homes, forts, businesses, and community buildings. Wood remained the dominant construction material for all types of buildings in North America well into the nineteenth century, and continues to be the dominant material for housing today.

Benefits

Wood offers many benefits as a building material. These include:

Sustainability

Wood from well managed sources is a sustainable building material. Wood is a renewable resource that captures carbon dioxide (CO_2), a potent greenhouse gas, as it grows. The US Environmental Protection Agency (EPA) estimates that the production (harvesting, processing, and transportation) of one tonne of framing lumber requires only about 15 percent of the carbon emissions than the production of one tonne of recycled steel, and 12 percent of the carbon emissions then the production of one tonne of concrete. Green building certification systems, such as the Leadership in Energy and

Environmental Design (LEED) program, often recognize the sustainability value of wood by allocating credits or points for using wood from managed sources.

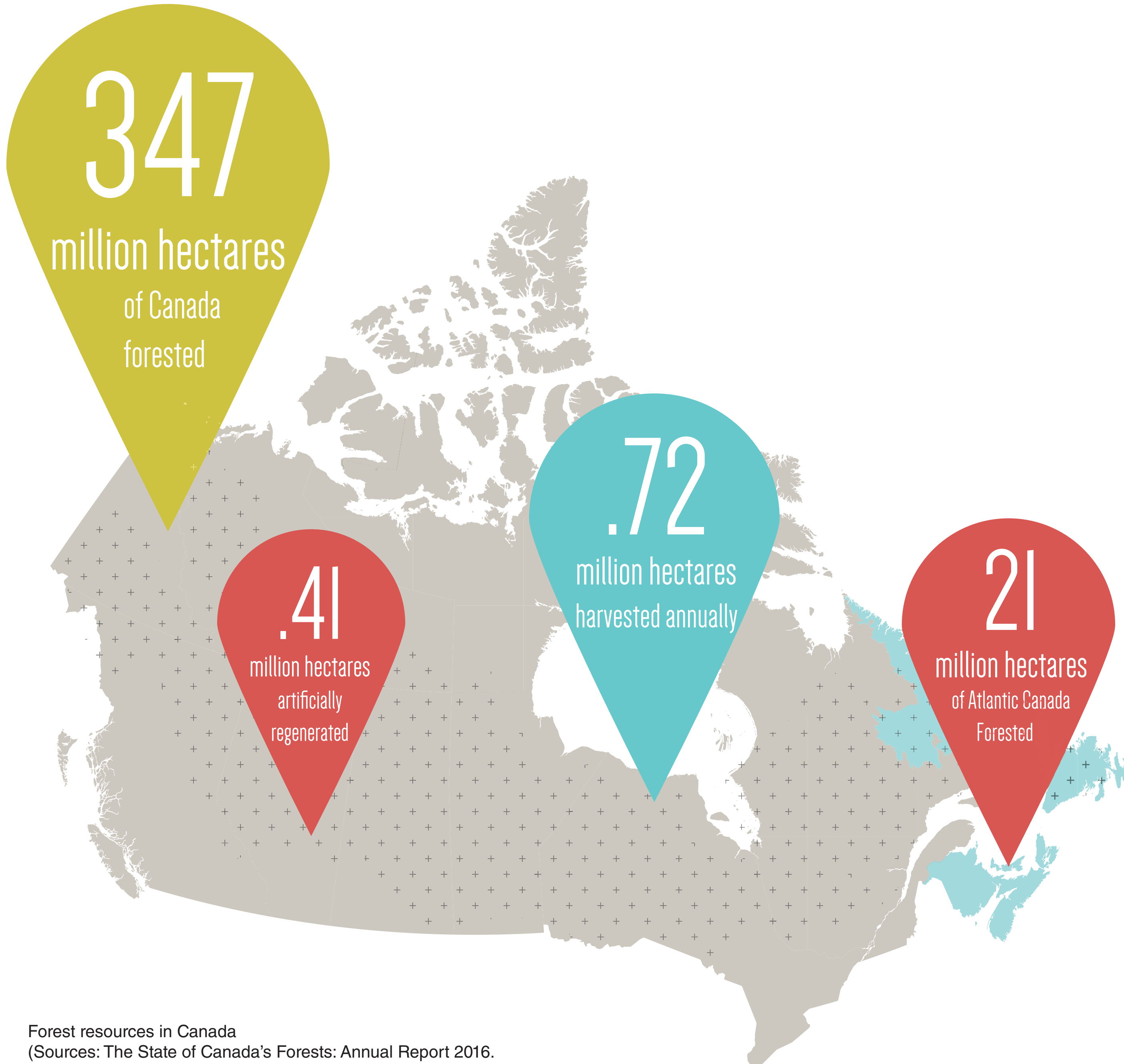
Locally-sourced
Much of Atlantic Canada has a robust forestry sector that enables lumber to be sourced from within the region. This reduces the environmental impact of transporting lumber and keeps a higher proportion of construction dollars within the regional economy.

Cost
In many situations wood-framed buildings provide a cost advantage over other structural materials. Please see below for a detailed illustration of the cost benefits of wood.

Urban Density
Municipal and provincial governments across Canada are increasingly aiming to reduce urban sprawl and to intensify the use of land in already built-up areas. As previously low-density areas are up-zoned to allow for mid-rise buildings, 4 to 6 storey wood construction can help cities meet their urban density targets and allow developers to build up these areas by leveraging the cost advantages of building with wood.

Building with Timber - Paths into the Future: An exhibition representing the state of the art in sustainable and modern timber architecture. Munich 2017.

Abundance
Canada is blessed with abundant forest resources; approximately 38 percent, or 347 million hectares, of Canada's landmass is forested. Atlantic Canada accounts for about 21 million hectares of the productive forest resource. Only about 1 million hectares of Canada's forest resources are harvested annually, and in the years 2003 to 2008 an average of only 74 percent of the allowable cut was harvested.



Forest resources in Canada
(Sources: The State of Canada's Forests: Annual Report 2016.
Wood Market Statistics in Canada, Including Pulp and Paper. 2010.)

2 Mid Rise Opportunities

2.1 Planning Rationale for Mid-Rise

Mid-rise construction, when developed appropriately to the context, can contribute to the vitality and success of cities by increasing the density of people in a neighbourhood. Density itself is not the end goal, but rather the benefits that density can bring. These include:

Commercial Success

The success of retail stores and restaurants depends on many factors. However, all other factors being equal, these commercial establishments benefit from a higher density of potential customers, and higher density areas can typically support a greater diversity of commercial options.

Mid-rise buildings also themselves create new commercial opportunities, because the ground floor can be designed to accommodate new retail or restaurant space.

Mobility Options

Like commercial businesses, a higher density of residents usually supports better transit service and a more cost-effective transit system. Although it can be more expensive to build transit systems in higher-density areas, due to the cost of land and the challenges of construction, this is typically more than offset by the additional ridership such an environment encourages.

The diversity of businesses supported by density also encourages other mobility options; when a neighbourhood includes many shops and restaurants residents are able to walk or bicycle to reach the services they need.

Infrastructure Efficiencies

The installation, maintenance, and replacement of infrastructure is a major cost for municipalities. This cost can be reduced by increasing density in established areas to take advantage of existing infrastructure, rather than expanding infrastructure into undeveloped areas. For example, Stantec conducted a report for Halifax Regional Municipality in 2013 that found shifting development patterns from outlying areas to the established core could save up to $650 million in new road construction costs by the year 2031.

In cases where development does get built on greenfield (previously-undeveloped) sites, higher densities can be positive because they spread the cost of infrastructure among more people.

Density can, of course, be accomplished using high-rise buildings. However, in the right context a mid-rise building offers many advantages over high-rise buildings. These include:

Integration with Existing Neighbourhoods

Redevelopment of established sites can be challenging due to concerns from residents in the surrounding neighbourhood. Common concerns include shadows, wind, loss of privacy, traffic, and drastic change of the neighbourhood character. Mid-rise construction can reduce many of these fears because the form of the building reduces many of the physical impacts (wind, shadow) and because the height is a gentler transition to lower density neighbourhoods.

Comfortable Streetscape

The same concerns that often drive neighbourhood opposition to high-rise buildings are important considerations for creating a comfortable streetscape. Given a choice, pedestrians will choose to use streets that are sunny and warm instead of cold, are not windy, and have street and building dimensions that feel “human-scale”. Mid-rise construction supports the qualities that make for a comfortable streetscape.

Cost

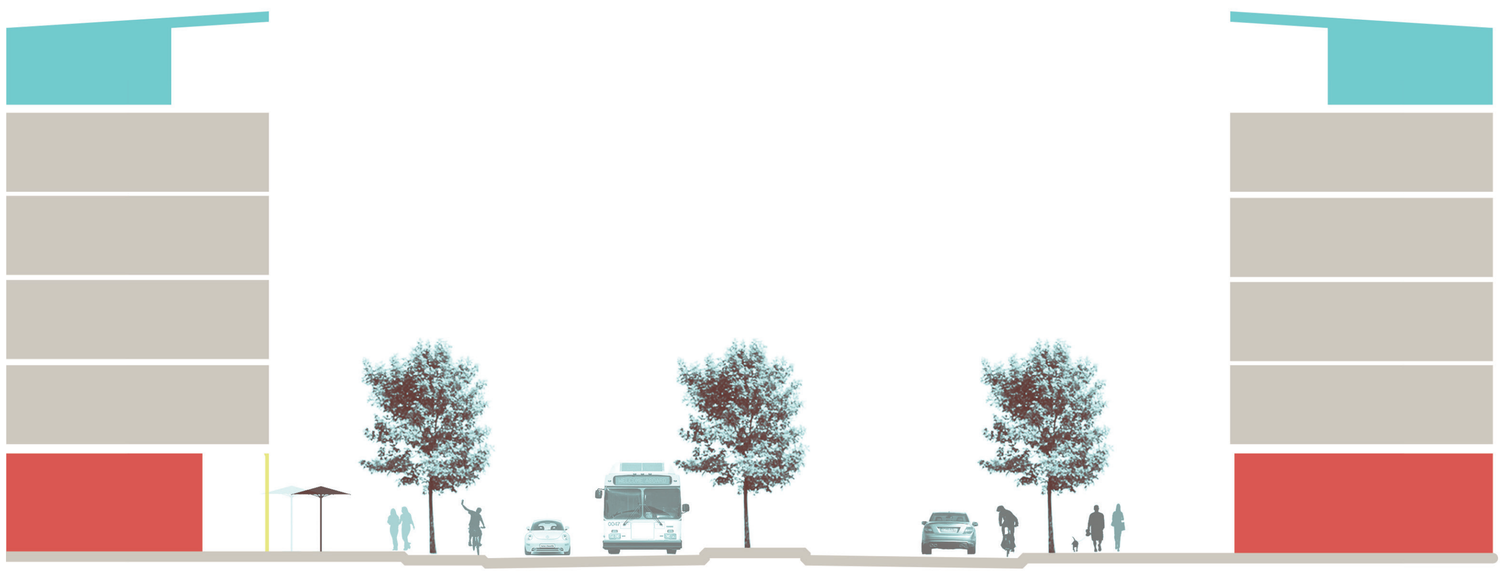
The construction cost per unit of usable floor area is typically higher in high-rise buildings than in mid-rise buildings. This is due to many factors, such as increased excavation costs for multiple levels of underground parking, higher structural costs, and a higher proportion of the building made unusable by structural elements and circulation space (especially elevators). The higher construction costs for high-rise buildings can be justified in some cases, such as in downtowns where land is at a premium and the cost of land becomes much higher in proportion to other elements of the building's cost. However, Atlantic Canadian cities have many areas where land costs may not justify the cost burden of high-rise construction, and where mid-rise construction becomes the preferred approach for its cost advantages.

Revitalize Corridors

Many Atlantic Canadian cities have secondary commercial corridors that are developed with older, low-rise commercial buildings. Revitalizing these streets requires private investment in new buildings; however, the market demand may not be present to support the high upfront investment required for high-rise buildings on these corridors. Mid-rise construction enables landowners to intensify the use of their land - providing an incentive to reinvest - in a manner that is less risky than high-rise construction.

Housing Options

A vibrant city requires diverse housing options, so that residents can find a place to live that meet their unique needs. Housing that works for a single student may not meet the requirements of a retiree couple or a large family. Mid-rise buildings provide options for residents looking for something in-between the detached home and the high-rise tower. Mid-rise buildings can put residents closer to services and free them from the responsibilities of maintaining their own home, while at the same time providing more access to the outdoors and connection to the activity of the city than they might get in a high-rise tower.



The revitalization of urban corridors creates opportunities for human scale mid-rise development.

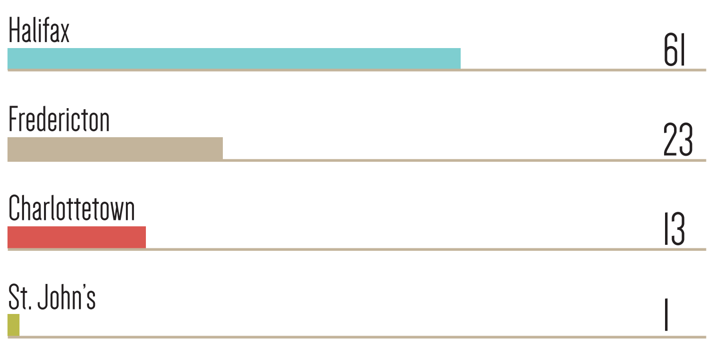
2.2 Atlantic Canadian Trends in Mid-Rise Construction

Turner Drake & Partners prepared a comprehensive market study to determine the anticipated number of mid-rise mixed-use and residential buildings that will be constructed over the next five years in four major centres of Atlantic Canada. The projected future demand for mid-rise construction was calculated using past building permit trends, along with correlated economic projections for the Consumer Price Index, residential sales and rentals, population, and new housing prices.

The past trends in building height and estimated future trends of the same highlight the potential demand for 4-6 storey wood frame construction. These projections were developed based on past trends, which only account for current zoning and building code rules; it is conceivable that changes to these rules will increase the proportion of permits issued for mid-rise construction in the future.

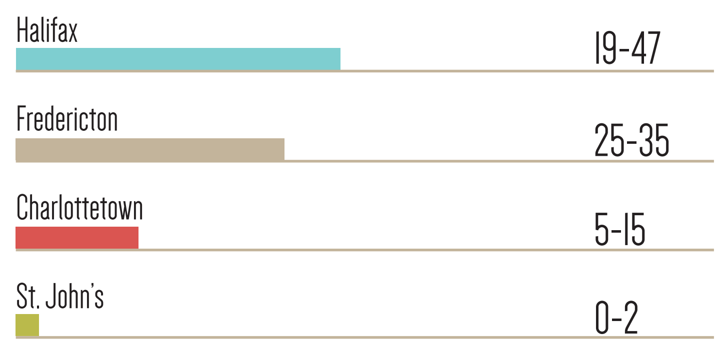
These projections indicate a healthy demand for mid-rise buildings in Atlantic Canada over the next few years, particularly in Halifax, Charlottetown, and Fredericton.

Past Mid-Rise Building Permits 2011- 2015



Projected Mid-Rise Building Permits 2016- 2020

(status quo - assuming current zoning and building code rules)



2.3 Future Opportunities

It is very important to note that the projected future demand for mid-rise construction presented above only indicates demand based on past conditions, and does not account for regulatory changes that might make mid-rise construction even more viable and desirable. Planning projects currently underway are likely to transition parts of these cities into areas tailored to mid-rise development. More importantly, changes to the NBC to enable mid-rise wood construction may improve the viability of mid-rise construction and increase the number of these buildings constructed.

What exact impact the changes to the NBC will have on mid-rise construction rates is difficult to quantify. However, the experiences in British Columbia and Ontario offer case studies on how building code changes can drive construction. In 2009, British Columbia increased the permitted height for wood frame construction to 18 metres, or six storeys. This spurred a wave of mid-rise construction; by early 2016, the Canadian Mortgage and Housing Corporation counted more than 250 wood frame, mid-rise buildings constructed or nearing construction.

Ontario amended its building code in January of 2015 to increase the height limit for wood construction to six storeys and floor areas. By March, the City of Hamilton had issued the first permit in Ontario for such a building. One year later, 15 mid-rise wood buildings were under construction in Ontario. As Ontario builders, engineers, and architects familiarize themselves with the design and construction of wood mid-rise buildings, this number will only increase.

2.4 Planning Changes

Many Atlantic Canadian municipalities are recognizing the benefits of mid-rise developments, and are adjusting their land use (zoning) regulations to enable and encourage them.

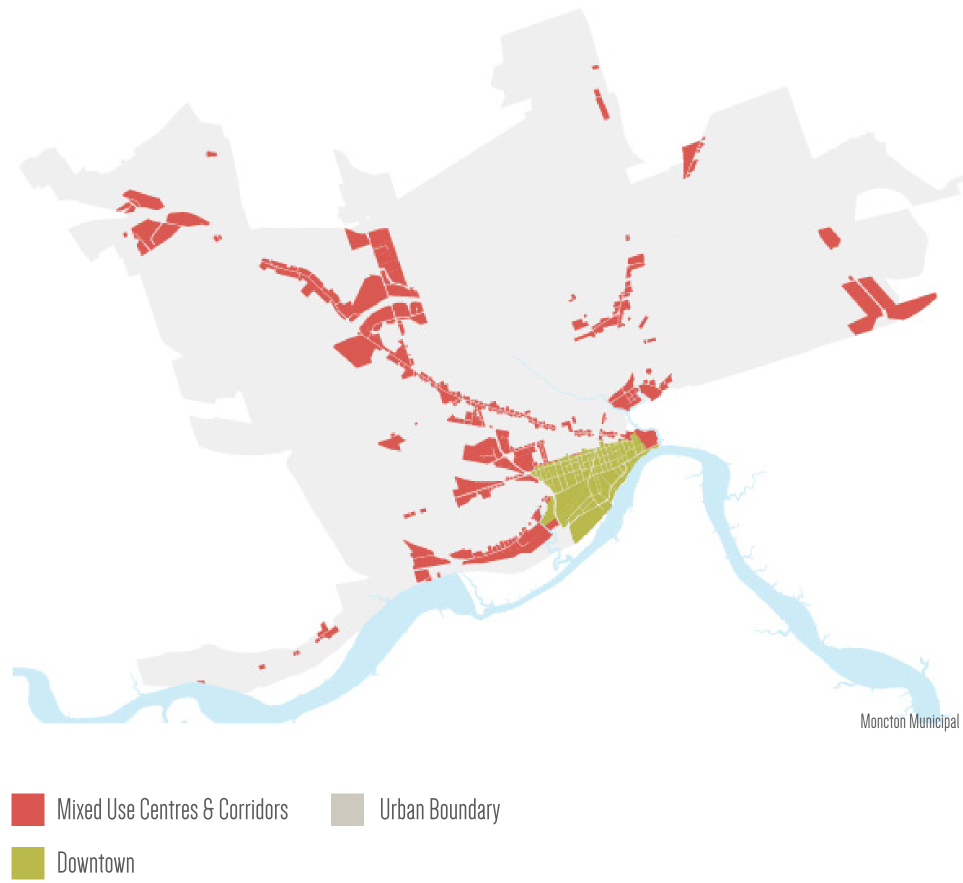
Envision St. John's

Envision St. John's Draft Municipal Plan will, when adopted, become the city's principle planning document. It was developed as a result of a comprehensive and intensive consultation process and is based on a new understanding of how St. John's should grow and develop over the next decade. While the plan continues to limit the overall building height in the downtown to four storeys, it also identifies areas across the city for future intensification through redevelopment of vacant or underutilized sites where mid-rise buildings are deemed appropriate and desirable. In particular, the plan identifies eight areas as having potential for future redevelopment and intensification for a mix of commercial, residential and other uses. These areas are typically commercial areas located on transit-serviced roadways that are characterized by vacant and underutilized sites, including large parking areas.

Halifax Regional Centre Plan
Halifax is currently updating its plan for the Regional Centre, a 33 square kilometre area encompassing the downtowns of Halifax and Dartmouth, and their respective inner suburbs. The final plan is expected to be adopted in 2017. However, consultations to date suggest that 21 percent of new growth in the next 15 years could occur on 14 mid-rise corridors. These corridors are currently lower in density, with buildings typically not exceeding three storeys tall. Under the new Centre Plan, as proposed to date, permitted heights on these corridors could be updated to six storeys.

Plan Moncton

The 2014 Municipal Plan for the City of Moncton established a new Mixed Use Centres and Corridors Designation and applied it to four distinct areas and to collector and arterial streets that link the city's mixed use centres to the downtown. The goal for these areas is to eventually transition these existing commercial nodes and corridors to mix use residential/commercial. For those parts of the city identified as mixed use centres or corridors, the Plan recommends the preparation of neighbourhood or secondary planning strategies. Even though the City can currently only prepare one Secondary/Master Plan per year due to limited resources, medium to high density residential growth will likely occur within identified neighborhoods, along commercial corridors and in the downtown.



Moncton Municipal Plan

Charlottetown's Official Plan

The City of Charlottetown is currently undertaking a review of its Official Plan and Zoning & Development Bylaw. New planning policy for the Plan will be informed by neighbourhood planning exercises and by several comprehensive planning studies which have been prepared in recent years. The more recent plans, the 500 Lot Plan and Waterfront Plan, have already been adopted into the City's Official Plan. A third plan, the Eastern Gateway Waterfront Master Plan is in the process of being adopted as a part of the Official Plan. Together, these three planning studies allocate significant lands to mid-rise development. Recently adopted policy of the Official Plan directs the location of medium rise multiple dwelling unit buildings to the downtown core area and the waterfront. Even though much of the current as-of-right zoning in Charlottetown's core remains limited to 3 storeys, new density bonusing provisions allow for discretionary 2-3 additional storeys in many parts of the downtown. Additionally, much of Charlottetown's waterfront is now zoned for 6-storey buildings.

Fredericton City Centre Plan

The City Centre Plan, last updated in 1997, was completely rewritten in 2015 and lays the foundation for the transformation and enrichment of Fredericton's downtown over the coming decades. The City is currently working on adopting the City Centre Plan into the statutory regulatory planning framework. The Plan defines a hierarchy of built form character areas that guides appropriate uses and building typologies for development that is consistent with the character and surrounding context. Three of those character areas, Downtown Mix-Use, Downtown Core and Downtown High Street, which together comprise about 70% of the city centre's developable landmass will allow for mid-rise buildings between 5 and 6 storeys high once the City Centre Plan is adopted into Fredericton's Municipal Plan.

3 Cost Comparison

3.1 Methodology

QS Online Cost Consultants Inc. from Halifax completed a Class C cost estimate for a six storey building that is currently being built in Kamloops, British Columbia. The purpose of this estimate was to analyze a real-life wood mid-rise structure built by an experienced builder, apply Atlantic Canadian cost and structural engineering conditions and to generate a comparative cost analysis for four different construction methods.

All models are 6 storeys and estimates were performed for the following configurations:

- one base model that is comprised of 1 level of concrete construction and 5 levels of wood construction above;
- one model with all wood construction;
- one model with all concrete construction; and
- and one model with all structural steel construction.

All models are based on a 4-foot-deep frost foundation, without basement, slab on grade (SOG). The ground floor is considered as vacant shell space for commercial tenants, while the upper five floors are residential.

The cost estimate is based on an initial capital cost perspective and has not included any impacts from a detailed life cycle costing analysis.

The four Class C Estimates of the “Base Model” and the three other structural configurations of the “Original” base model, are intended to provide a realistic allocation of direct construction costs for these structures, in Halifax, Nova Scotia area.

From the documentation and information provided, quantities for all major elements were assessed or measured where possible and priced at rates considered competitive for a project of this type under a stipulated form of contract in this region of Nova Scotia.

The class C detailed elemental estimates for all building types can be downloaded from our website: **www.atlanticwoodworks.ca**

Front elevation of building studied for cost comparison

Special Inclusions:

- Insurance included within general requirements
- Design and pricing allowance (10%)
- Construction allowance (4%)

Exclusions:

- Underground parking – all models include a foundation with 4” slab on grade
- Soft costs
- Productivity
- HST

Other Important Considerations:

- Retail Material Pricing
- Supply and install pricing matrix
- Commercial space in base model is open space
- Stairwell and elevator shaft fire rating exceeds allowable 2015 NBC mid-rise provisions of 1 hour and is costed at a 1.5 hour non combustible assembly – resulting in approximately $75,000 premium for wood models
- Cross Laminated Timber (CLT) costs included in base model design for roof and projection sub elements - resulting in approximately $100,000 premium for base model ($15/ft2 | $37/ft2 with roof coverings). Some CLT was removed and replaced with wood-i-joists and parallel cord trusses in 6 storey wood model resulting in a $30,000 cost savings.
- Acoustic measures (STC ratings) were included within floors and walls of base model and 6 storey wood model. Acoustic measures were not taken into consideration for steel and concrete models as information was not available and there are too many options. Typically acoustic mineral wool batt cost between $3.50 - $4.25 / ft2 for 3” - 4” thick
- Drawings not 100% complete and lead to minor assumptions
- Costs represent a finished building – giving an accurate estimate of total building costs

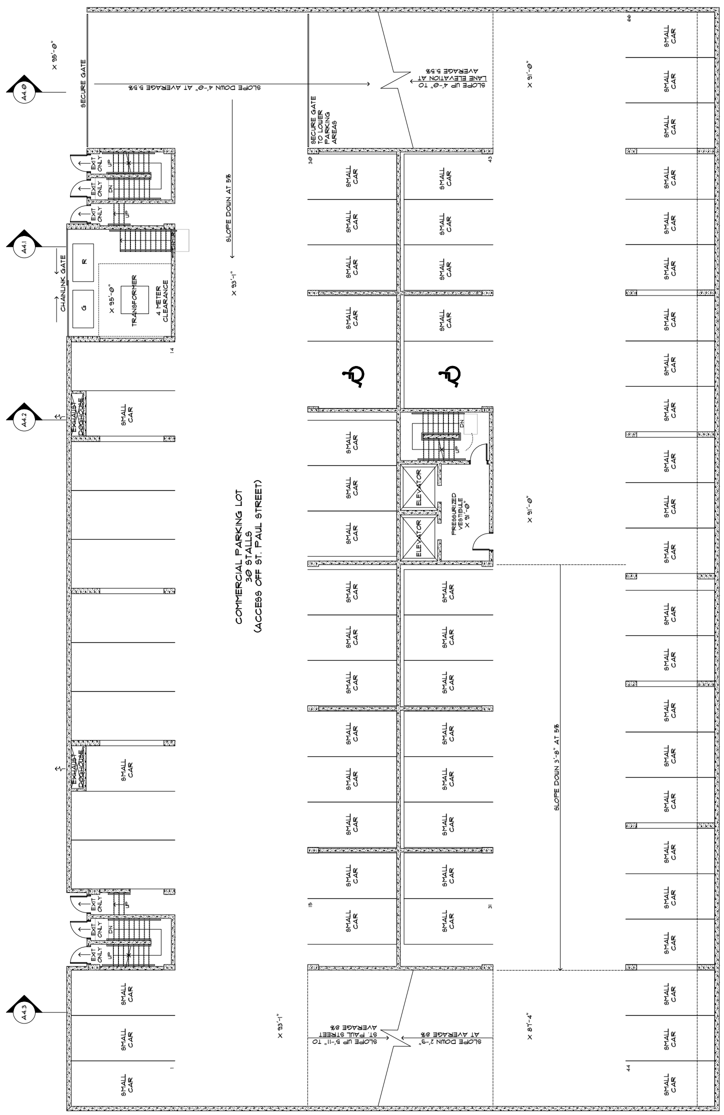
3.2 Base Model

The base model for the cost study is an existing concrete/wood structure that was constructed in Kamloops British Columbia located at 444 St. Paul Street. The project consists of a 5 storey wood frame structure founded upon a 4 storey cast in place concrete structure. The 18 inch thick level 2 concrete slab acts as a platform for which the 5 storey wood frame structure is supported. The underground three levels of parking are constructed using cast in place concrete.

Tri-City Contracting from Kamloops, B.C. has provided the design for the base model, which was the basis for considering costs for three additional structural configurations. BMR Engineering from Halifax provided high level structural interpretations of the models as applicable to the Halifax area, and these directives were included in the logic of the cost estimates. Bluegreen Architecture Inc., from Vernon and Kamloops, BC, provided the architectural drawings. G.L. Bevan Pritchard Engineering Ltd., from Vancouver, BC, provided the structural drawings.

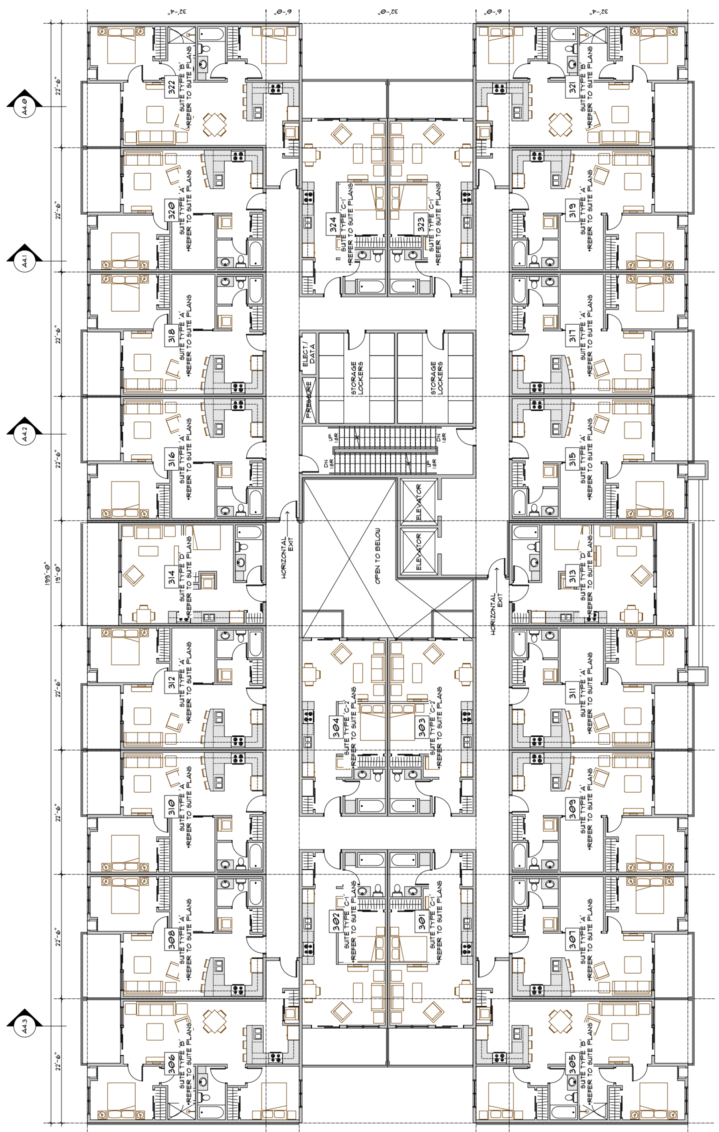
Rendering 444 St. Paul Street

Parkade Level 1 Plan

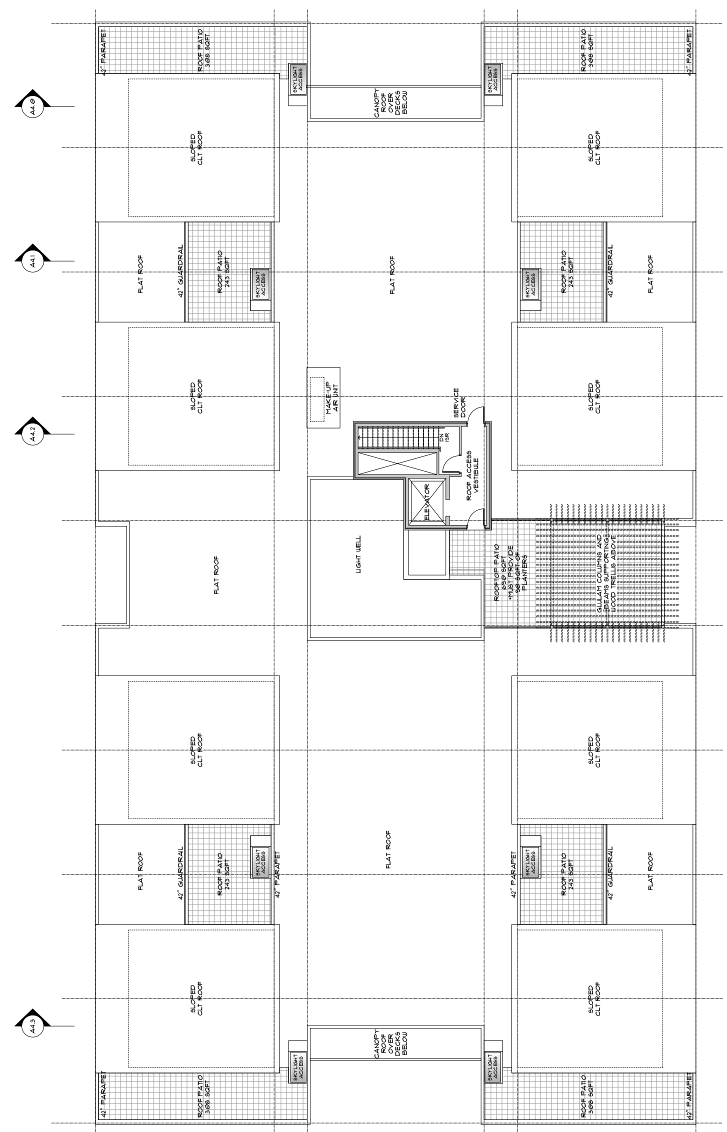


Level 1 Floor Plan

Typical Floor Plan



Roof Plan



3.3 Cost Estimates

1 Level Concrete - 5 Levels Wood Frame

ELEMENTAL COST SUMMARY
CLASS C ESTIMATE

Atlantic Woodworks — **GFA 113,380 SF**

1 Level Concrete - 5 Levels Wood Frame — **September 15, 2016**

Element/Sub-Element	Ratio	Quantity	Unit	Unit Rate	Cost	Total Cost		$ / GFA	%
A SHELL						**$ 7,667,349**		**$ 67.63**	**45.76%**
A1 Sub-Structure						$ 381,802		$ 3.37	2.28%
A1.1 Standard Foundations	0.17	19,396	Sf	19.68	381,801.67		$ 3.37		
A1.2 Special Foundations	0.00	0	Sf	-	-		$ -		
A1.3 Basement Excavation	0.00	0	CY	-	-		$ -		
A2 Structure						$ 3,660,925		$ 32.29	21.85%
A2.1 Lowest Floor Construction	0.17	19,396	Sf	6.50	126,139.15		$ 1.11		
A2.2 Upper Floor Construction	0.83	93,984	Sf	32.02	3,008,925.46		$ 26.54		
A2.3 Roof Construction	0.17	19,396	Sf	27.11	525,860.61		$ 4.64		
A3 Exterior Enclosure						$ 3,624,622		$ 31.97	21.63%
A3.1 Walls Below Grade	0.00	0	Sf	-	-		$ -		
A3.2 Walls Above Grade	0.56	63,374	Sf	42.75	2,709,118.18		$ 23.89		
A3.3 Entrances	0.00	138	Lvs	2,168.84	299,300.00		$ 2.64		
A3.4 Roof Covering	0.17	19,396	Sf	19.13	371,051.00		$ 3.27		
A3.5 Projections	0.05	5,220	Sf	46.96	245,152.50		$ 2.16		
B INTERIORS						**$ 3,843,100**		**$ 33.90**	**22.93%**
B1 Partitions & Doors						$ 478,880		$ 4.22	2.86%
B1.1 Partitions	0.24	26,945	Sf	6.92	186,480.40		$ 1.64		
B1.2 Doors	0.01	615	Lvs	475.45	292,400.00		$ 2.58		
B2 Finishes						$ 1,596,985		$ 14.09	9.53%
B2.1 Floor Finishes	1.00	113,380	Sf	5.56	630,314.00		$ 5.56		
B2.2 Ceiling Finishes	1.00	113,380	Sf	3.77	427,907.60		$ 3.77		
B2.3 Wall Finishes	2.67	302,926	Sf	1.78	538,763.15		$ 4.75		
B3 Fittings & Equipment						$ 1,767,235		$ 15.59	10.55%
B3.1 Fittings & Fixtures	1.00	113,380	Sf	10.63	1,205,235.00		$ 10.63		
B3.2 Equipment	1.00	113,380	Sf	3.12	354,000.00		$ 3.12		
B3.3 Elevators	0.00	2	No.	104,000.00	208,000.00		$ 1.83		
B3.4 Conveying Systems	0.00	0	Sum	-	-		$ -		
C SERVICES						**$ 2,165,819**		**$ 19.10**	**12.93%**
C1 Mechanical						$ 1,545,630		$ 13.63	9.22%
C1.1 Plumbing & Heating	1.00	113,380	Sf	8.25	935,385.00		$ 8.25		
C1.2 Fire Protection	1.00	113,380	Sf	1.63	185,070.00		$ 1.63		
C1.3 Ventilation	1.00	113,380	Sf	3.75	425,175.00		$ 3.75		
C2 Electrical						$ 620,189		$ 5.47	3.70%
C2.1 Electrical & Systems	1.00	113,380	Sf	5.47	620,188.60		$ 5.47		
					SUB TOTAL EXCLUDING SITE AND ANCILLARY	**$ 13,676,267**		**$ 120.62**	**81.62%**
D SITE & ANCILLARY WORK						**$ -**		**$ -**	**0.00%**
D1 Site Work						$ -		$ -	0.00%
D1.1 Site Development	0.00	0	Sf	-	-		$ -		
D1.2 Mechanical Site Services	0.00	0	Sf	-	-		$ -		
D1.3 Electrical Site Services	0.00	0	Sf	-	-		$ -		
D2 Ancillary Work						$ -		$ -	0.00%
D2.1 Demolition	0.00	0	Sf	-	-		$ -		
D2.2 Alterations	0.00	0	Sf	-	-		$ -		
					SUB TOTAL INCLUDING SITE AND ANCILLARY	**$ 13,676,267**		**$ 120.62**	**81.62%**
Z GENERAL REQUIREMENTS & ALLOWANCES									
Z1 General Requirements & Fee	%					$ 971,015		$ 8.56	5.79%
Z1.1 General Requirements	2.0%				273,525.35		$ 2.41		
Z1.2 Fee	5.0%				697,489.63		$ 6.15		
					SUB TOTAL	**$ 14,647,282**		**$ 129.19**	**87.41%**
Z2 Allowances	%					$ 2,109,209		$ 18.60	12.59%
Z2.1 Design Allowance	10.0%				1,464,728.23		$ 12.92		
Z2.2 Escalation Allowance	0.0%				-		$ -		
Z2.3 Construction Allowance	4.0%				644,480.42		$ 5.68		
Taxes	**0.0%**					**$ -**		**$ -**	**0.00%**
					TOTAL ESTIMATED CONSTRUCTION COST	**$ 16,756,491**	**SF**	**$ 147.79**	100.00%
							m2	**$ 1,590.80**	

QS Online

Total Unit Rate ($/SF GFA)

$ 147.79

Total Building Cost

$ 16,756,491

Total Unit Rate ($/SF GFA)

$ 165.23

Total Building Cost

$ 18,733,499

6 Levels Structural Steel Frame

ELEMENTAL COST SUMMARY
CLASS C ESTIMATE

Atlantic Woodworks — **GFA 113,380 SF**

6 Levels Structural Steel Frame — **September 15, 2016**

Element/Sub-Element	Ratio	Quantity	Unit	Unit Rate	Cost	Total Cost		$ / GFA	%
A SHELL						**$ 7,836,680**		**$ 69.12**	**41.83%**
A1 Sub-Structure						$ 366,134		$ 3.23	1.95%
A1.1 Standard Foundations	0.17	19,396	Sf	18.88	366,133.59		$ 3.23		
A1.2 Special Foundations	0.00	0	Sf	-	-		$ -		
A1.3 Basement Excavation	0.00	0	CY	-	-		$ -		
A2 Structure						$ 3,841,031		$ 33.88	20.50%
A2.1 Lowest Floor Construction	0.17	19,396	Sf	6.50	126,139.15		$ 1.11		
A2.2 Upper Floor Construction	0.83	93,984	Sf	33.33	3,132,096.88		$ 27.62		
A2.3 Roof Construction	0.17	19,396	Sf	30.05	582,794.64		$ 5.14		
A3 Exterior Enclosure						$ 3,629,516		$ 32.01	19.37%
A3.1 Walls Below Grade	0.00	0	Sf	-	-		$ -		
A3.2 Walls Above Grade	0.56	63,374	Sf	42.78	2,711,077.48		$ 23.91		
A3.3 Entrances	0.00	138	Lvs	2,168.84	299,300.00		$ 2.64		
A3.4 Roof Covering	0.17	19,396	Sf	19.13	371,051.00		$ 3.27		
A3.5 Projections	0.05	5,220	Sf	47.53	248,087.30		$ 2.19		
B INTERIORS						**$ 5,198,921**		**$ 45.85**	**27.75%**
B1 Partitions & Doors						$ 1,543,351		$ 13.61	8.24%
B1.1 Partitions	0.99	112,062	Sf	11.16	1,250,951.30		$ 11.03		
B1.2 Doors	0.01	615	Lvs	475.45	292,400.00		$ 2.58		
B2 Finishes						$ 1,888,335		$ 16.65	10.08%
B2.1 Floor Finishes	1.00	113,380	Sf	5.56	630,314.00		$ 5.56		
B2.2 Ceiling Finishes	1.00	113,380	Sf	6.34	719,258.00		$ 6.34		
B2.3 Wall Finishes	2.67	302,926	Sf	1.78	538,763.15		$ 4.75		
B3 Fittings & Equipment						$ 1,767,235		$ 15.59	9.43%
B3.1 Fittings & Fixtures	1.00	113,380	Sf	10.63	1,205,235.00		$ 10.63		
B3.2 Equipment	1.00	113,380	Sf	3.12	354,000.00		$ 3.12		
B3.3 Elevators	0.00	2	No.	104,000.00	208,000.00		$ 1.83		
B3.4 Conveying Systems	0.00	0	Sum	-	-		$ -		
C SERVICES						**$ 2,254,255**		**$ 19.88**	**12.03%**
C1 Mechanical						$ 1,545,630		$ 13.63	8.25%
C1.1 Plumbing & Heating	1.00	113,380	Sf	8.25	935,385.00		$ 8.25		
C1.2 Fire Protection	1.00	113,380	Sf	1.63	185,070.00		$ 1.63		
C1.3 Ventilation	1.00	113,380	Sf	3.75	425,175.00		$ 3.75		
C2 Electrical						$ 708,625		$ 6.25	3.78%
C2.1 Electrical & Systems	1.00	113,380	Sf	6.25	708,625.00		$ 6.25		
					SUB TOTAL EXCLUDING SITE AND ANCILLARY	**$ 15,289,856**		**$ 134.85**	**81.62%**
D SITE & ANCILLARY WORK						**$ -**		**$ -**	**0.00%**
D1 Site Work						$ -		$ -	0.00%
D1.1 Site Development	0.00	0	Sf	-	-		$ -		
D1.2 Mechanical Site Services	0.00	0	Sf	-	-		$ -		
D1.3 Electrical Site Services	0.00	0	Sf	-	-		$ -		
D2 Ancillary Work						$ -		$ -	0.00%
D2.1 Demolition	0.00	0	Sf	-	-		$ -		
D2.2 Alterations	0.00	0	Sf	-	-		$ -		
					SUB TOTAL INCLUDING SITE AND ANCILLARY	**$ 15,289,856**		**$ 134.85**	**81.62%**
Z GENERAL REQUIREMENTS & ALLOWANCES									
Z1 General Requirements & Fee	**%**					$ 1,085,580		$ 9.57	5.79%
Z1.1 General Requirements	2.0%				305,797.13		$ 2.70		
Z1.2 Fee	5.0%				779,782.68		$ 6.88		
					SUB TOTAL	**$ 16,375,436**		**$ 144.43**	**87.41%**
Z2 Allowances	**%**					$ 2,358,063		$ 20.80	12.59%
Z2.1 Design Allowance	10.0%				1,637,543.63		$ 14.44		
Z2.2 Escalation Allowance	0.0%				-		$ -		
Z2.3 Construction Allowance	4.0%				720,519.20		$ 6.35		
Taxes	**0.0%**					**$ -**		**$ -**	**0.00%**
					TOTAL ESTIMATED CONSTRUCTION COST	**$ 18,733,499**	**SF**	**$ 165.23**	100.00%
							m2	**$ 1,778.49**	

QS Online

Total Unit Rate ($/SF GFA)

$ 160.49

Total Building Cost

$ 18,196,575

6 Levels Structural Concrete Frame

ELEMENTAL COST SUMMARY
CLASS C ESTIMATE

Atlantic Woodworks — **GFA 113,380 SF**

6 Levels Structural Concrete Frame — **September 15, 2016**

Element/Sub-Element	Ratio	Quantity	Unit	Unit Rate	Cost	Total Cost		$ / GFA	%
A SHELL						**$ 7,492,439**		**$ 66.08**	**41.17%**
A1 Sub-Structure						$ 439,478		$ 3.88	2.42%
A1.1 Standard Foundations	0.17	19,396	Sf	22.66	439,477.66		$ 3.88		
A1.2 Special Foundations	0.00	0	Sf	-	-		$ -		
A1.3 Basement Excavation	0.00	0	CY	-	-		$ -		
A2 Structure						$ 3,374,057		$ 29.76	18.54%
A2.1 Lowest Floor Construction	0.17	19,396	Sf	6.50	126,139.15		$ 1.11		
A2.2 Upper Floor Construction	0.83	93,984	Sf	28.50	2,678,370.03		$ 23.62		
A2.3 Roof Construction	0.17	19,396	Sf	29.36	569,548.09		$ 5.02		
A3 Exterior Enclosure						$ 3,678,904		$ 32.45	20.22%
A3.1 Walls Below Grade	0.00	0	Sf	-	-		$ -		
A3.2 Walls Above Grade	0.56	63,374	Sf	43.56	2,760,465.93		$ 24.35		
A3.3 Entrances	0.00	131	Lvs	2,284.73	299,300.00		$ 2.64		
A3.4 Roof Covering	0.17	19,396	Sf	19.13	371,051.00		$ 3.27		
A3.5 Projections	0.05	5,220	Sf	47.53	248,087.30		$ 2.19		
B INTERIORS						**$ 5,104,937**		**$ 45.03**	**28.05%**
B1 Partitions & Doors						$ 1,543,351		$ 13.61	8.48%
B1.1 Partitions	0.99	112,062	Sf	11.16	1,250,951.30		$ 11.03		
B1.2 Doors	0.01	615	Lvs	475.45	292,400.00		$ 2.58		
B2 Finishes						$ 1,794,351		$ 15.83	9.86%
B2.1 Floor Finishes	1.00	113,380	Sf	5.56	630,314.00		$ 5.56		
B2.2 Ceiling Finishes	1.00	113,380	Sf	5.51	625,274.00		$ 5.51		
B2.3 Wall Finishes	2.67	302,926	Sf	1.78	538,763.15		$ 4.75		
B3 Fittings & Equipment						$ 1,767,235		$ 15.59	9.71%
B3.1 Fittings & Fixtures	1.00	113,380	Sf	10.63	1,205,235.00		$ 10.63		
B3.2 Equipment	1.00	113,380	Sf	3.12	354,000.00		$ 3.12		
B3.3 Elevators	0.00	2	No.	104,000.00	208,000.00		$ 1.83		
B3.4 Conveying Systems	0.00	0	Sum	-	-		$ -		
C SERVICES						**$ 2,254,255**		**$ 19.88**	**12.39%**
C1 Mechanical						$ 1,545,630		$ 13.63	8.49%
C1.1 Plumbing & Heating	1.00	113,380	Sf	8.25	935,385.00		$ 8.25		
C1.2 Fire Protection	1.00	113,380	Sf	1.63	185,070.00		$ 1.63		
C1.3 Ventilation	1.00	113,380	Sf	3.75	425,175.00		$ 3.75		
C2 Electrical						$ 708,625		$ 6.25	3.89%
C2.1 Electrical & Systems	1.00	113,380	Sf	6.25	708,625.00		$ 6.25		
SUB TOTAL EXCLUDING SITE AND ANCILLARY						**$ 14,851,632**		**$ 130.99**	**81.62%**
D SITE & ANCILLARY WORK						**$ -**		**$ -**	**0.00%**
D1 Site Work						$ -		$ -	0.00%
D1.1 Site Development	0.00	0	Sf	-	-		$ -		
D1.2 Mechanical Site Services	0.00	0	Sf	-	-		$ -		
D1.3 Electrical Site Services	0.00	0	Sf	-	-		$ -		
D2 Ancillary Work						$ -		$ -	0.00%
D2.1 Demolition	0.00	0	Sf	-	-		$ -		
D2.2 Alterations	0.00	0	Sf	-	-		$ -		
SUB TOTAL INCLUDING SITE AND ANCILLARY						**$ 14,851,632**		**$ 130.99**	**81.62%**
Z GENERAL REQUIREMENTS & ALLOWANCES									
Z1 General Requirements & Fee	%					$ 1,054,466		$ 9.30	5.79%
Z1.1 General Requirements	2.0%				297,032.63		$ 2.62		
Z1.2 Fee	5.0%				757,433.21		$ 6.68		
SUB TOTAL						**$ 15,906,097**		**$ 140.29**	**87.41%**
Z2 Allowances	%					$ 2,290,478		$ 20.20	12.59%
Z2.1 Design Allowance	10.0%				1,590,609.75		$ 14.03		
Z2.2 Escalation Allowance	0.0%				-		$ -		
Z2.3 Construction Allowance	4.0%				699,868.29		$ 6.17		
Taxes	**0.0%**					**$ -**		**$ -**	**0.00%**
TOTAL ESTIMATED CONSTRUCTION COST						**$ 18,196,575**	**SF**	**$ 160.49**	100.00%
							m2	**$ 1,727.52**	

QS Online

Total Unit Rate ($/SF GFA)

$ 145.66

Total Building Cost

$ 16,515,400

6 Levels Wood Frame

ELEMENTAL COST SUMMARY
CLASS C ESTIMATE

Atlantic Woodworks GFA 113,380 SF

6 Levels Wood Frame September 15, 2016

Element/Sub-Element	Ratio	Quantity	Unit	Unit Rate	Cost	Total Cost		$ / GFA	%
A SHELL						**$ 7,452,636**		**$ 65.73**	**45.13%**
A1 Sub-Structure						$ 352,738		$ 3.11	2.14%
A1.1 Standard Foundations	0.17	19,396	Sf	18.19	352,738.34		$ 3.11		
A1.2 Special Foundations	0.00	0	Sf	-	-		$ -		
A1.3 Basement Excavation	0.00	0	CY	-	-		$ -		
A2 Structure						$ 3,527,968		$ 31.12	21.36%
A2.1 Lowest Floor Construction	0.17	19,396	Sf	6.50	126,139.15		$ 1.11		
A2.2 Upper Floor Construction	0.83	93,984	Sf	30.92	2,905,659.08		$ 25.63		
A2.3 Roof Construction	0.17	19,396	Sf	25.58	496,169.91		$ 4.38		
A3 Exterior Enclosure						$ 3,571,929		$ 31.50	21.63%
A3.1 Walls Below Grade	0.00	0	Sf	-	-		$ -		
A3.2 Walls Above Grade	0.56	63,374	Sf	41.92	2,656,425.65		$ 23.43		
A3.3 Entrances	0.00	138	Lvs	2,168.84	299,300.00		$ 2.64		
A3.4 Roof Covering	0.17	19,396	Sf	19.13	371,051.00		$ 3.27		
A3.5 Projections	0.13	15,266	Sf	16.06	245,152.50		$ 2.16		
B INTERIORS						**$ 3,878,897**		**$ 34.21**	**23.49%**
B1 Partitions & Doors						$ 514,678		$ 4.54	3.12%
B1.1 Partitions	0.28	32,133	Sf	6.92	222,277.60		$ 1.96		
B1.2 Doors	0.01	615	Lvs	475.45	292,400.00		$ 2.58		
B2 Finishes						$ 1,596,985		$ 14.09	9.67%
B2.1 Floor Finishes	1.00	113,380	Sf	5.56	630,314.00		$ 5.56		
B2.2 Ceiling Finishes	1.00	113,380	Sf	3.77	427,907.60		$ 3.77		
B2.3 Wall Finishes	2.76	313,302	Sf	1.72	538,763.15		$ 4.75		
B3 Fittings & Equipment						$ 1,767,235		$ 15.59	10.70%
B3.1 Fittings & Fixtures	1.00	113,380	Sf	10.63	1,205,235.00		$ 10.63		
B3.2 Equipment	1.00	113,380	Sf	3.12	354,000.00		$ 3.12		
B3.3 Elevators	0.00	2	No.	104,000.00	208,000.00		$ 1.83		
B3.4 Conveying Systems	0.00	0	Sum	-	-		$ -		
C SERVICES						**$ 2,147,961**		**$ 18.94**	**13.01%**
C1 Mechanical						$ 1,545,630		$ 13.63	9.36%
C1.1 Plumbing & Heating	1.00	113,380	Sf	8.25	935,385.00		$ 8.25		
C1.2 Fire Protection	1.00	113,380	Sf	1.63	185,070.00		$ 1.63		
C1.3 Ventilation	1.00	113,380	Sf	3.75	425,175.00		$ 3.75		
C2 Electrical						$ 602,331		$ 5.31	3.65%
C2.1 Electrical & Systems	1.00	113,380	Sf	5.31	602,331.25		$ 5.31		
SUB TOTAL EXCLUDING SITE AND ANCILLARY						**$ 13,479,494**		**$ 118.89**	**81.62%**
D SITE & ANCILLARY WORK						**$ -**		**$ -**	**0.00%**
D1 Site Work						$ -		$ -	0.00%
D1.1 Site Development	0.00	0	Sf	-	-		$ -		
D1.2 Mechanical Site Services	0.00	0	Sf	-	-		$ -		
D1.3 Electrical Site Services	0.00	0	Sf	-	-		$ -		
D2 Ancillary Work						$ -		$ -	0.00%
D2.1 Demolition	0.00	0	Sf	-	-		$ -		
D2.2 Alterations	0.00	0	Sf	-	-		$ -		
SUB TOTAL INCLUDING SITE AND ANCILLARY						**$ 13,479,494**		**$ 118.89**	**81.62%**
Z GENERAL REQUIREMENTS & ALLOWANCES									
Z1 General Requirements & Fee	**%**					$ 957,044		$ 8.44	5.79%
Z1.1 General Requirements	2.0%				269,589.88		$ 2.38		
Z1.2 Fee	5.0%				687,454.21		$ 6.06		
SUB TOTAL						**$ 14,436,538**		**$ 127.33**	**87.41%**
Z2 Allowances	**%**					$ 2,078,862		$ 18.34	12.59%
Z2.1 Design Allowance	10.0%				1,443,653.83		$ 12.73		
Z2.2 Escalation Allowance	0.0%				-		$ -		
Z2.3 Construction Allowance	4.0%				635,207.69		$ 5.60		
Taxes	**0.0%**					**$ -**		**$ -**	**0.00%**
TOTAL ESTIMATED CONSTRUCTION COST						**$ 16,515,400**	**SF**	**$ 145.66**	100.00%
							m2	**$ 1,567.91**	

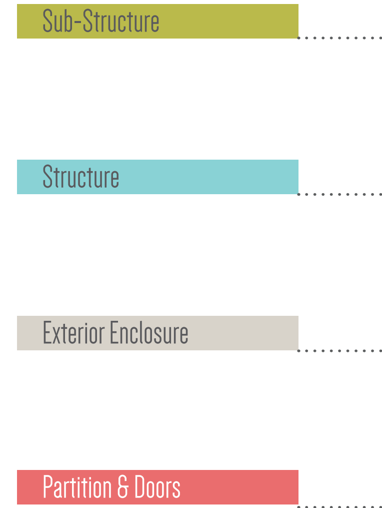
QS Online

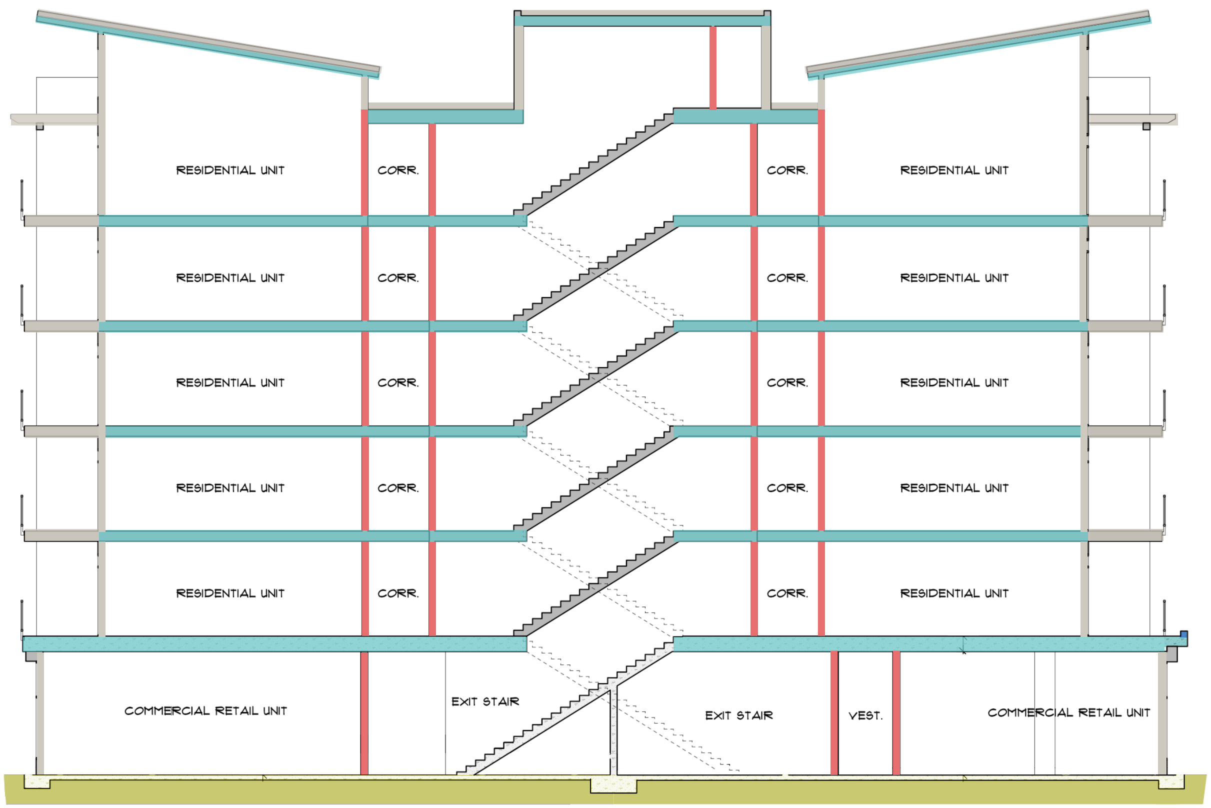
3.4 Cost Comparison

The cost analysis findings indicate that wood construction models are the least expensive to build.

There are a number of minor cost differences between the Kamloops region and Halifax in regards to material supply and labour costs. This estimate does not provide a detailed breakdown of these differences. Specialty lumber such as mass timber is less expensive in the Kamloops area, while standard dimensional lumber such as SPF #1 & #2, is without significant cost variations as it is available in each respective region.

The fixed price differences of the materials can be off-set in both regions by various levels of crewing, productivity, and payroll levels. Construction cost differences in this type of construction are within a range that could be considered generally congruent to each region. Further detailed analysis would be required to determine specifics.





Section of building studied for cost comparison

	6 Levels Steel	6 Levels Concrete	1 Level Concrete 5 Levels Wood	6 Levels Wood
	GFA : 113,380 SF*	GFA : 113,380 SF*	GFA : 113,380 SF*	GFA : 113,380 SF*
	$/SF GFA	$/SF GFA	$/SF GFA	$/SF GFA
Sub-Structure A11 Standard Foundations	3.23	3.88	3.37	3.11
Structure A21 Lowest Floor Construction A22 Upper Floor Construction A23 Roof Construction	33.88	29.76	32.29	31.49
Exterior Enclosure A32 Walls Above Grade A33 Entrances A34 Roof Covering A35 Projections	32.01	32.45	31.97	31.50
Partition & Doors B11 Partitions B12 Doors	13.61	13.61	4.22	4.54
Total Unit Rate	165.23	160.49	147.79	145.66
Total Building Cost	18,733,499	18,196,575	16,756,491	16,515,400

* The building design used for this cost comparison analysis exceeds the maximum allowable gross floor area of 96,875 square feet as defined by the NBC. The larger building floor area was achieved by adding additional fire walls.

3.5 Major Cost Differences

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood
Sub-Structure			
A11 Foundations			
• 2nd heaviest model	• 3rd heaviest model	• heaviest model	• Lightest model
$381,802	$366,134 (-4%)	$439,478 (+13%)	$352,738 (-8%)

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood

Structure

A22 Upper Floor Construction

1 Level Concrete 5 Levels Wood

- 1st Level Concrete stair well and elevator shaft
- 2nd Level Floor is 18” transfer slab
- Level 3,4,5,6 – Wood models and steel have 1.5” of concrete topping with in-floor heating
- Generally floor systems are Wood-I-Joists 16” O.C varying in lengths.
- R28 insulation
- Structural composite beams and posts are included in design - **roughly a $366,000 premium**
- Includes tie-rod and shrinkage compensators
- Firewall consists of 10” CMU
- Most of upper floor is load bearing and facilitates partitions

$3,008,925

6 Levels Steel

- Structural steel members are based on lbs/ft2 - from engineer directive
- Metal Deck
- 1.5” Concrete Top
- Acoustic measures were not taken into consideration – see other important considerations in introduction.

$3,132,097 (+4%)

6 Levels Concrete

- This model was based on mostly column type of support for the upper floor (self supporting slab) with very small proportion of concrete demising walls
- If concrete demising walls were included in the analysis, the supporting slab unit rate for concrete would increase accordingly
- Columns support up to 20’ spans or more
- Gypsum wall board assemblies used mainly for demising within residential units and for fire separations
- Less Involved to assemble this element
- Acoustic measures were not taken into consideration – see other important considerations in introduction.

$2,678,370 (-12%)

6 Levels Wood

- Upper floor quantities and costs include all elements which support the upper floor - including partitions. That is why quantities are not counted in B11 Partitions, but included in B23 wall finishes
- The wood wall and structural composite beams system is also included in this model - roughly a $366,000 premium
- Wood unit rate is higher than concrete in upper floor construction because the concrete model is based on column support elements only and that the slab is otherwise self supporting
- If concrete demising walls were included in the analysis, the supporting slab unit rate for concrete would increase accordingly

$2,905,659 (-4%)

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood

Structure

A23 Roof Construction

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood
• Roof on top level is similar construction to floor on Levels 3,4 and 5 • Mass timber elements included in base model design and costing – 5 ply Cross Laminated Timber (CLT)	• Unit rate is higher for both steel and concrete models – similar assembly to upper floor	• Unit rate is higher for both steel and concrete models – similar assembly to upper floor	• Where possible, CLT was replaced with lower cost regional products like parallel cord truss and wood I-joist systems (similar construction to upper floor) as CLT is not produced in Atlantic Canada
$525,861	$582,795 (+10%)	$569,548 (+8%)	$496,170 (-6%)

A32 Walls Above Grade

- Only structural differences between models – minimal cost variations
- All models required R28 thermal and vapor barrier assemblies
- The main construction differences are: In wood models, exterior walls are load bearing and in steel/concrete models walls above grade are not load bearing and only stiffened to address wind and other impact loads.

I Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood

Partition & Doors

B11 Partitions

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood
• Partition quantities in the wood models are for non-load bearing applications such as bathroom, closet, and other minor space separations within each unit • Most load bearing partitions are covered in Upper floor construction • Less cost in base model vs. 6 storey wood model due to 1st level concrete podium with no partition walls	• Generally in the steel and concrete models, all demising, corridor, bathroom, bedroom and closet partitions are non load bearing, therefore, all are accounted for in the partitions element • The quantity of partitions will be reflected in B2.3 wall finishes where wall finish quantities are all the same	• Same as steel description	• Slight increase from base model due to partitions on 1st level
$186,480	$1,250,951 (+85%)	$1,250,951 (+85%)	$222,278 (+16%)

B22 Ceiling Finishes

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood
• Finishes consists of 1x3” strapping to joists with 2 layers of 5/8” GWB - one side pained	• More work and cost associated with suspending 2 layers of 5/8” GWB from concrete upper floor, compared to strapping	• Same as steel description	• Same as base model
$427,908	$719,258 (+41%)	$719,258 (+41%)	$427,908

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood

Services

C21 Electrical

1 Level Concrete, 5 Levels Wood

- Standard wood frame construction is permitted by the Canadian Electrical Code to use NMD90 or equivalent type cables
- This is a non-metallic-sheathed cable which can be used for exposed wiring in dry locations where not exposed to mechanical damage.
- A conservative savings was attributed to the electrical unit rate due to lack of details in the design, however, a more detailed review would be suggested to determine a more accurate finding of savings for this element

$602,331

6 Levels Steel

- For steel stud wiring BX type (metallic sheathed) cable is the normally accepted practice. The cost to supply and install metallic sheathed cables vs. non-metallic sheathed cables will result in a higher cost
- Electec engineering provided a letter to verify the cost differences between building types (see appendix)

$708,625 (+15%)

6 Levels Concrete

- Same as steel description

$708,625 (+15%)

6 Levels Wood

- Same as base model

$602,331

1 Level Concrete 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood

Site Development

- The overall percent % impact to the overall project value is not equally measurable for all building conditions so similar to the basement and parking, this amount has been omitted from the analysis

General Requirements

Z11 Insurance

- Insurance costs are included in the total cost of this element
- The general requirements and fee % values can be considered as one sum if the project delivery is to be through a General Contractor
- As noted, this is to address costs of all requirements to complete the work which are not listed within the estimate and is only an allowance

1 Level Concrete / 5 Levels Wood	6 Levels Steel	6 Levels Concrete	6 Levels Wood
$20,000,000 x 0.0045	$20,000,000 x 0.0027	$20,000,000 x 0.0027	$20,000,000 x 0.0045
$90,000	$54,000 (-40%)	$54,000 (-40%)	$90,000
Payment per Month	Payment per Month	Payment per Month	Payment per Month

Appendix

Letter QS Online Cost Consultants Inc.
Letter BMR Structural Engineering
Letter Electec Engineering Incorporated

January 4, 2016

Atlantic Woodworks
21535 Fort Lawrence Road
Amherst, Nova Scotia

Attention: Mr. Patrick Crabbe

RE: 6 Storey Construction – Original Model Comparison – Firewall

Dear Mr. Crabbe,

Please find enclosed four separate estimates for the model comparisons as requested.

Tri-City Contracting from Kamloops, B.C. has provided a base model, described below, which was the basis for three additional structural configurations of costs to be considered.
High level structural interpretations of the models as applicable to the Halifax area, were provided by BMR Engineering from Halifax and these directives were included in the logic of the estimates.

The Architectural drawings are drawn by Bluegreen Architecture Inc. from Vernon and Kamloops BC.
The Structural drawings are drawn by G. L. Bevan Pritchard Engineering Ltd., Vancouver BC.

All models are 6 storey, and varying in typical composition from the base model which is comprised of 1 level of concrete construction and 5 levels of wood construction above, 1 model with all wood construction, 1 model with all concrete construction, and 1 model with all structural steel construction.

All models are based on a 4' foot deep frost foundation, without basement, SOG, and the ground floor is considered as vacant shell space for commercial tenants, while the upper 5 floors are for residential.

The cost analysis findings indicate that wood construction models are the least expensive to build.
This determination is simply from an initial capital cost perspective and has not included any impacts from a detailed life cycle costing analysis. Soft costs are also excluded from the estimate logic.

Electrical wiring costs have been proven to be slightly less per SF for wood framed structures versus those structures with steel stud framing. This difference is due mainly to the allowable use of non-armoured cable / wiring.

A modest savings was attributed to the Electrical unit rate due to lack of details in the design, however a more detailed review would be suggested to determine a more accurate finding of savings for this element.

As requested, the "All Wood" model was further modified to exclude masonry CMU units from the elevator shaft and replaced with wood framed and gypsum assemblies.

The impact of this alteration is a modest cost savings for the Upper Floor and Roof Construction as the shaft extended from the footings up through the roof elevation.

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As requested, the "All Wood" model was further modified to exclude the 5-ply CLT panels included in the "Base Model" with 24" deep parallel chord wood trusses.
This alteration impacted only the sloped roofs in the Roof Construction, the remainder of the roof area was flat and constructed of various depths of TJI joists and their associated assemblies and supports.

The impact of this change was a capital or direct cost savings to this portion of the Roof construction, but the trade-off of the capital cost saving would be an overall increased duration to the Project.
The multiple tasks of installing a significantly greater number of items in the parallel chord assembly, takes longer versus the approach of simply "laying in place" the full length CLT panels using a crane.

Although this report is not including impacts to soft costs or cash flow differentials, the result of extending any project's duration, cascades into a direct impact to occupancy timing, construction financing costs, extended exposure to weather and seasons, to point out a few cascading impacts.

In regards to mass timber applications such as the CLT example, and other manufactured wood panelized systems for walls and floors, and where the capital cost for supply of these products is higher than the considered substitute parallel chord truss system for example, it would be reasonable to conclude that the return on investment for these manufactured products, is not in the hard or direct costs incurred during construction, but rather in the soft or indirect costs evaluations of the overall project achieved by a shortening the overall duration of the project and gaining earlier occupancy.

We note, that there are a number of minor cost differences between the Kamloops region and Halifax in regards to material supply and labour costs, but this report does not provide a detailed breakdown of these differences.

Specialty lumber such as Douglas Fir and mass timber is cheaper in the Kamloops area versus the Halifax area, mainly due to the impact of shipping costs, while standard dimensional lumber such as SPF #1 & #2, is without significant cost variations as it is similarly available in each respective region.
The bulk of the lumber used in the Base Model is SPF dimensional lumber mainly due to it's availability and lower cost.

The fixed price differences of the materials can be off-set in both regions by various levels of crewing, productivity, and payroll levels.

Construction cost differences in this type of construction are within a range that could be considered generally congruent to each region.
Further detailed analysis as discussed, would be required to determine specifics beyond these Class C estimates.

We remain available to you and your team, for any questions or if further assistance is required, please do not hesitate to contact our office.

Respectfully,

Renaud Francoeur, PQS, LEED AP
Per; QS Online Cost Consultants Inc.

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September 14, 2016

Upland Urban Planning + Design Inc.
5663 Cornwallis Street
Halifax, Nova Scotia
B3K 1B6

ATTENTION: Mr. Steffen Kaubler

RE: WOOD FRAMING COMPARISON - ATLANTIC WOOD WORKS PROJECT KAMLOOPS, B.C./HALIFAX, N.S. PROJECT

Dear Sir

As requested the undersigned undertook a study of an existing concrete/wood structure that was constructed in Kamloops British Columbia located at 444 St. Paul Street. Preliminary structural drawings completed by G.L. Bevan-Pritchard Engineering Ltd of Vancouver, British Columbia were provided for our use and information. The purpose of the study was to determine if the structural framing used in Kamloops could be adapted to the Halifax, Nova Scotia market. The review focused on what structural design revisions would need to be incorporated to ensure conformance with local building codes. As part of our scope of work recommendations were provided to QS Online Cost Consultants Inc. so that a true local representation could be completed. Costing information for the same basic design model constructed using all steel or all concrete structures was also provided.

The 444 St. Paul street project consists of a 5 storey wood frame structure founded upon a 4 storey cast in place concrete structure. The 18 inch thick level 2 concrete slab acts as a platform for which the 5 storey wood frame structure is supported. The lower three levels of parking are constructed using cast in place concrete.

Buildings designed and constructed in Canada need to conform to the National Building Code. The Code provides minimum design loads based on use and occupancy and geographic location of the building. The floor loads for the same use and occupancy remain constant but snow, wind, rain and seismic loads vary by geographic location.

A roof structure needs to be designed for dead and live loads. The dead load is comprised of the self-weight of the structure plus permanent components such as ceilings, flooring, electrical and mechanical systems. Live load is comprised of snow loads based on the geographic location of the building or a minimum load specified in the Code. Snow loads are adjusted depending on roof obstructions and slopes.

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the strength of experience

The basic roof design snow load for a building in Kamloops is 34.3 psf(pounds per square foot), snow load for the same basic structure in Halifax is 44.3 psf, an increase of 29%. Based on the increase in snow load the roof structure in Halifax would be slightly more costly than an equivalent roof structure in Kamloops.

As previously stated floor structure gravity design loads would be the same for a building constructed in Kamloops as Halifax for the same use and occupancy. The floor structural layout and loads as shown on the drawings completed by Bevan-Pritchard Engineering would be adequate for a building located in Halifax. The level 2 cast in place concrete slab supporting the 5 storey wood frame structure for the Kamloops location would also be adequate for a Halifax location as there is only a marginal increase in the total load created from the increased snow load on the roof.

Lateral loads are imposed upon a building from wind and seismic events. Both need to be evaluated and the most stringent condition governs the design. The wind load in Halifax is approximately 45% higher than a similar building in Kamloops. However the seismic lateral load for a building in Halifax is less than a similar building in Kamloops by approximately 30%.

Foundation sizing is a function of the total load the building is supporting as well as the allowable soil bearing capacity which varies based on site soil conditions. The building in Kamloops has been designed for an allowable bearing capacity of 3075 psf. An anticipated building in Halifax routinely has an allowable bearing capacity of 3000 psf. For cost comparison purposes the structural drawings for the building in Kamloops can be used for the same building in Halifax.

If we can be of further assistance please let me know.

Yours truly,

BMR STRUCTURAL ENGINEERING

Scott M. Underhill, P. Eng.

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October 20th, 2016

QS Online Cost Consultants Inc.
PO Box 25177, Clayton Park PO
Halifax, NS B3M 4H4

Attention: Mr. Renaud Francoeur PQS, LEED AP

RE: Wood Frame Construction

Dear Mr. Francoeur;

At the request of and approval by QS Online Cost Consultants Inc., Electec Engineering Inc. is providing this correspondence as an opinion on the cost of standard wiring for residential wood frame vs steel frame construction.

Standard wood frame construction is permitted by the Canadian Electrical Code to use NMD90 or equivalent type cables. This is a non-metallic-sheathed cable which can be used for exposed wiring in dry locations where not exposed to mechanical damage. For residential construction mechanical damage could result from cable installed horizontally just above floor level to electric baseboard heaters under windows. The risk is damage to the conductor from drywall screws or fasteners used for the mounting of the heaters.

Armoured cables such as a BX type may be installed in wood frame construction (combustible) or non-combustible construction for dry locations only. For steel stud construction installing BX type cable is the normally accepted practice.

The cost to supply and install non-metallic sheathed cables vs metallic sheathed cables for residential wood frame construction will result in a higher cost for the metallic sheathed cable.

Please contact me if you have any questions regarding the above.

Best Regards,

Richard Joudrey

Richard Joudrey, P. Eng.

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