THE EXPANSION OF MID-RISE WOOD-FRAME RESIDENTIAL DESIGN ACROSS THE PROVINCE

MID-RISE WOOD-FRAME RESIDENTIAL CONSTRUCTION IN B.C.

Sail at the University of British Columbia, Vancouver, B.C.

INTRODUCTION

In cities across North America, the low-density sprawl that has characterized development since the mid-20th century is giving way to a growing landscape of mid-rise buildings; five- to six-storey structures that are more environmentally sustainable and cost effective because of their increased density—while still blending with existing neighbourhoods and helping to create livable communities that accommodate growing urban populations.

The migration of residents from rural areas to cities has been a global trend that continues to gather momentum. In Canada, the 2011 census confirmed that, for the first time, more than 80% of the population lives in urban areas. In Metro Vancouver, the population is expected to increase by more than 50% to a total of 3.4 million by 2040.[1]

In anticipation, many municipalities in B.C. have adopted policies that aim to accommodate growth through the densification of already developed areas; for example, by rezoning single-family residential neighbourhoods to permit mid-rise residential construction.

At the time of its inception in 1941, the National Building Code of Canada (NBCC) permitted wood buildings of up to 22.5 metres in height, which corresponds to eight storeys. This was a relatively common height for wood buildings of the day and many examples remain. However, subsequent changes to the code reduced the maximum allowable height to four storeys. This was the limit in British Columbia until 2009 when, after a comprehensive consultation process, the B.C. Building Code, which is based on the NBCC with modifications, was changed to permit six-storey wood-frame residential buildings.

Put in a global context, five-storey wood-frame buildings are permitted in the U.S. under the International Building Code; five-and-a-half storeys if the project has a mezzanine and six for an office occupancy. In the United Kingdom and Austria, there are examples of eight-storey buildings made from cross laminated timber (CLT) and, in 2012, a ten-storey CLT building was completed in Australia.

Since the B.C. code change, five- and six-storey wood-frame buildings have proven popular among developers, architects and contractors, who see them as a way to increase density at lower cost while reducing environmental impact. In less than five years, the number of mid-rise projects planned, underway or completed has risen to more than 150.

1 *Metro Vancouver 2040: Residential Growth Projections*, http://www.metrovancouver.org/planning/development/strategy/RGSBackgroundersNew/RGSMetro2040ResidentialGrowth.pdf Accessed February 11, 2014


Quattro 3, Surrey, B.C.
Completed in 2012
Cotter Architects Inc.

UNTIL RECENTLY, the code stipulated that steel or concrete be used for the primary structure of five- and six-storey residential buildings, even though wood has historically proven its capabilities in buildings of this height. The impetus behind the B.C. code change was, in fact, growing recognition that wood-frame construction can meet all code requirements for safety and performance in six-storey buildings, while simultaneously helping to achieve the goals of the provincial government's Climate Action Plan. The fact that wood construction is a cost-effective alternative to other materials at a time when affordable housing is urgently needed was also a consideration.

Although mid-rise buildings generally have a lighter carbon footprint per occupant than smaller buildings, this benefit is further enhanced with the use of wood, which not only grows naturally and is renewable, but has a much lighter carbon footprint than other major building materials.[2]

Wood's advantages in a green building context have been confirmed through life cycle assessment (LCA), an internationally recognized method of measuring the environmental impacts of materials, assemblies or buildings over their entire life cycles, from extraction or harvest of raw materials through manufacturing, transportation, installation, use, maintenance and disposal or recycling.

LCA studies have consistently shown that wood products offer clear environmental advantages in terms of embodied energy, air and water pollution, and greenhouse gas emissions.[3] LCA tools, such as the ATHENA Impact Estimator—which is free to download and can be used to compare the impacts of alternate building designs[4]—quantify what already makes sense intuitively: that manufacturing wood products is a clean, simple and low-energy process compared to that of many other products.

2 Werner, F. and Richter, K. 2007, *Wooden building products in comparative LCA: A literature review; A Synthesis of Research on Wood Products & Greenhouse Gas Impacts*, FPInnovations, 2010

3 *Building Materials in the Context of Residential Construction* – Phase I, 2005; *Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction* – Phase II, 2010; Consortium for Research on Renewable Industrial Materials

4 Athena Sustainable Materials Institute, www.athenasmi.org

FEATURED PROJECTS

This case study features a selection of recently completed mid-rise wood-frame residential complexes from across British Columbia. Projects vary in size, scope and style. Some include wood-frame construction on grade, while others feature wood-frame housing over a concrete podium used for retail and office space, or above underground parking. Some were expressly designed for rental, and others for sale as condominiums. Some aspects of the design are common to all, while others vary according to budget, site conditions or the preferences of the developer, design team or contractor.

LIBRARY SQUARE, KAMLOOPS, B.C.

JM ARCHITECTURE INC. (COMPLETED 2013)

Located on the north shore of the Thompson River in the interior of B.C., Library Square was built in three phases. It is comprised of one level of underground parking, a one-storey concrete podium that includes a library and retail space, and five storeys of wood-frame construction above, with a total of 153 strata and rental units.

SAIL, VANCOUVER, B.C.

ROSITCH HEMPHILL ARCHITECTS
(PHASE 1 COMPLETED 2013, PHASE 2 COMPLETED 2014)

Sail is a two-phase residential project in the Wesbrook neighbourhood at the University of British Columbia. Completed one year apart, the Phase 1 and 2 buildings include a total of 170 apartment units. The buildings are both six-storey wood-frame construction over two levels of underground parking.

RIVERPORT FLATS R5, RICHMOND, B.C.

COTTER ARCHITECTS INC. (COMPLETED 2014)

Riverport Flats R5 is a rental building overlooking the north arm of the Fraser River. Although originally conceived as a seven-storey concrete building, the change to the B.C. building code allowed for a more cost-effective design. The mixed-use project was realized with five storeys of wood-frame residential units over a one-storey concrete podium used for retail.

ARDEA AND HERONS LANDING, SAANICH, B.C.

KPL JAMES ARCHITECTURE (COMPLETED 2014)

This was a two-phase project with a total of 130 units split 60/40 between two structures. One building includes four storeys of wood-frame construction over one storey of underground parking. The other includes five storeys of wood-frame construction over parking and commercial office space. They are the first new rental buildings to be constructed in Saanich in 25 years. Because of the rental format, the municipality reduced the parking requirement to a single level.

"Without the code change in 2009, this project would not have been economically viable at six storeys."

- TONY JAMES, KPL JAMES ARCHITECTS

HILLCREST VILLAGE, FORT ST. JOHN, B.C.

MGA | MICHAEL GREEN ARCHITECTURE (COMPLETION EARLY 2015)

Given the size of the Hillcrest Village lot, the parking requirements for a four-storey structure would have resulted in the entire site being paved. Poor soil conditions in this part of the province make underground parking cost prohibitive. Instead, the architect chose six-storey wood-frame construction for part of the project to free up space for a play area. The two-phase project includes L-shaped four- and six-storey buildings that together form a courtyard. Phase 1 is a rental building, while Phase 2 will be sold as condominiums.

RENDERING

STRUCTURAL DESIGN

Even architects and engineers experienced in the design of four-storey wood buildings will say there are unique challenges to consider when adding two floors.

As an example, many cite an increase in required lateral load resistance for seismic and wind forces. The result is that more and stronger internal shear walls are needed than in a four-storey building, and these walls may have to be sheathed in wood panel on both sides. Because of their number, and the fact that shear walls may also have minimum continuous lengths, their positioning is an important early design consideration.

In the Hillcrest Village, Ardea and Herons Landing projects, the structural engineer required a rigorous consistency in the floor layouts at each level, so the shear walls could be positioned vertically above one another, as required by the building code.

FIGURE 01
Hillcrest Village: The layout of units is consistent throughout the building to permit the vertical alignment of shear walls.

In a six-storey structure, tie-downs are required to resist 'racking' and maintain the integrity of shear walls under lateral load conditions. These tie-downs take the form of sectional steel rods that run from the foundation in an all-wood structure, or from the uppermost concrete slab in a podium or garage structure to the top floor of the building. Each section of the rod typically extends through two storeys, and is connected top and bottom with couplers to create a continuous system. Rods are located at each end of the shear wall.

One important consideration for tie-downs is anchorage. Tie-downs can be anchored to a structural wood assembly or concrete element. For anchors into concrete, some requiring two feet of embedment, their positioning has to be coordinated with the beams or slab bands in the concrete structure.

According to the specifics of each project, further structural rigidity can be achieved using built-up or engineered wood posts. In the case of Sail, the structural engineer specified the use of Douglas-fir studs on the lower four floors of the building to provide additional strength to resist higher imposed loads.

Although a six-storey building must be designed to meet greater loads than a four-storey building, wood-frame construction is inherently light and does not attract the same magnitude of forces that a steel or concrete building would. At Sail, the architects decided to further minimize the magnitude of these forces by specifying a lightweight cladding rather than masonry or other heavy material. Although not subject to the same seismic forces, the design team at Hillcrest Village was concerned with the overall dead weight of the structure and specified a combination of cement-based board panels and fire retardant-treated western red cedar.

In Ardea and Herons Landing, the cladding is panelized stucco, while at Library Square it is a combination of brick masonry and stucco.

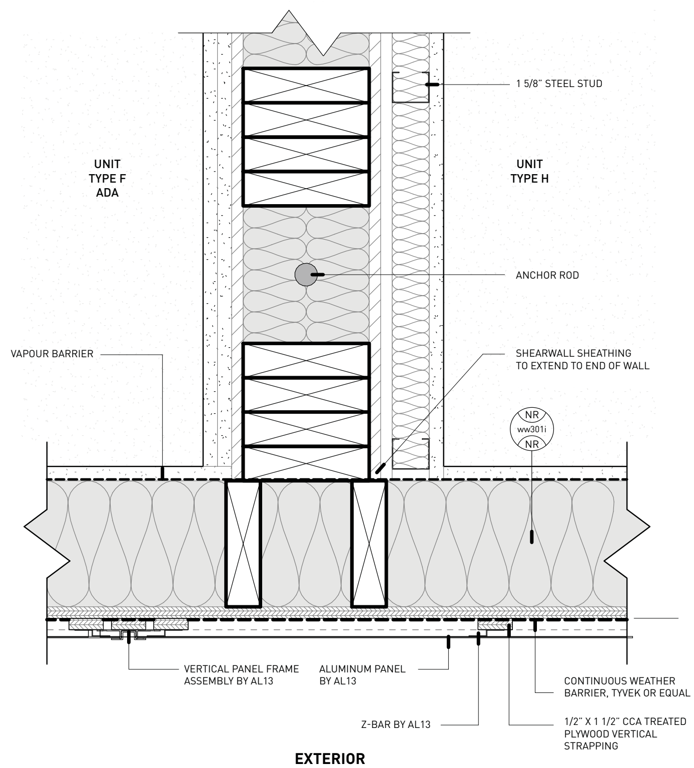
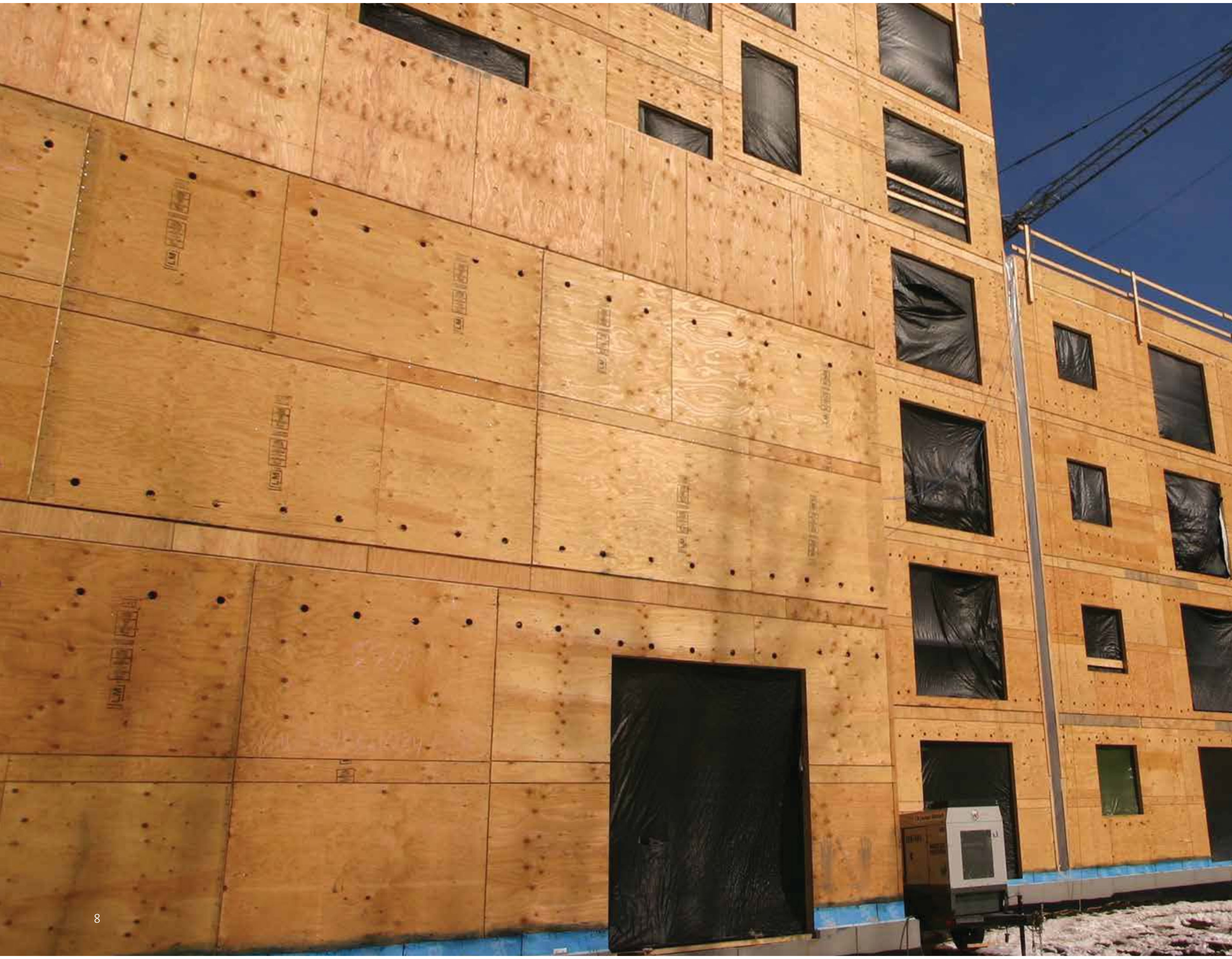


FIGURE 02
Riverport Flats R5: Plan detail showing the location of a typical tie-down rod close to the exterior wall of the building.



*Hillcrest Village,
Fort St. John, B.C.*

The poor soil conditions in Fort St. John combined with a modest budget of $1,345/square metre required that considerable attention be paid to the design of foundations. Although an underground parking structure wasn't affordable, the foundation needed to penetrate below the frost line—to a depth of about 1.5 metres. In order to prevent differential settlement, the foundation consists of a grid of caissons sunk below the frost line, then connected with concrete grade beams. Above this is a crawl space of approximately 900 millimetres clear height, framed with heavy timber.

SHRINKAGE AND DIFFERENTIAL MOVEMENT

In wood-frame construction at this scale, building designers must account for the fact that wood shrinks as it dries. Shrinkage continues from the time the wood is 'green' (unseasoned) until it reaches its Equilibrium Moisture Content (EMC), which averages 8-12% for most buildings in British Columbia.[5] While shrinkage is not generally an issue in small buildings, accumulated shrinkage over the height of a six-storey structure could be as much as 40mm.[6]

For most softwoods, radial shrinkage (across growth rings) is approximately 4% and tangential shrinkage (parallel to growth rings) is approximately 8% from green to EMC. Longitudinal shrinkage (parallel to grain) for vertical framing members is negligible. The majority of shrinkage occurs in the top plates, sill plates and sole plates, and possibly the floor joists, depending on how the floor is framed to the wall. Therefore, shrinkage must be considered in the design of the walls and floors.

Ideally, if the framing lumber has a moisture content equal to the average EMC, only slight shrinkage would occur after construction. However, the framing lumber is typically supplied at a higher moisture content. Surfaced green lumber, commonly stamped S-GRN, has an MC greater than 19% at the time of manufacture. Common dry lumber, including surfaced dry (S-DRY), kiln dried (KD) and kiln dried and heat treated (KD HT), have maximum MC of 19% at the time of manufacture. Less common is MC 15 or KD 15 with a maximum MC of 15% at the time of manufacture.

Mitigation measures depend largely on the use of kiln dried lumber for the head and sill plates in both exterior and interior load bearing walls, and the use of engineered wood—e.g., wood I-joists and parallel strand lumber beams—for the floors. For Sail, the design team specified double kiln dried wood for the first four floors and sill plates, bringing the moisture content down to 12% or less. This enabled the team to use conventional platform-frame construction.

Phase 1 of the Sail project has been in operation for more than a year, and the amount of accumulated shrinkage has been minimal, similar to that of a four-storey building.

PLATFORM AND BALLOON FRAMING

Two common types of framing in multi-storey wood-frame construction are platform framing and balloon framing. In platform framing, the joists sit on the top of the double top plates of the wall. In balloon framing, the floor structure frames onto the sides of the supporting walls with top mount hangers or hangs off ledgers that are fastened to the walls with side mount hangers. In the latter, sawn lumber joists don't play a huge role in overall movement from shrinkage because balloon framing—unlike platform framing—does not accumulate shrinkage over all floors.

5 Canadian Wood Council, 2013, *Vertical Movement in Wood Platform Frame Structures*, http://cwc.ca/wp-content/uploads/publications-Basics.pdf

6 This figure is based on an estimated 1% shrinkage perpendicular to grain for every 5% reduction in moisture content as stated in *Vertical Shrinkage in Wood Platform Frame Structures* cited above.

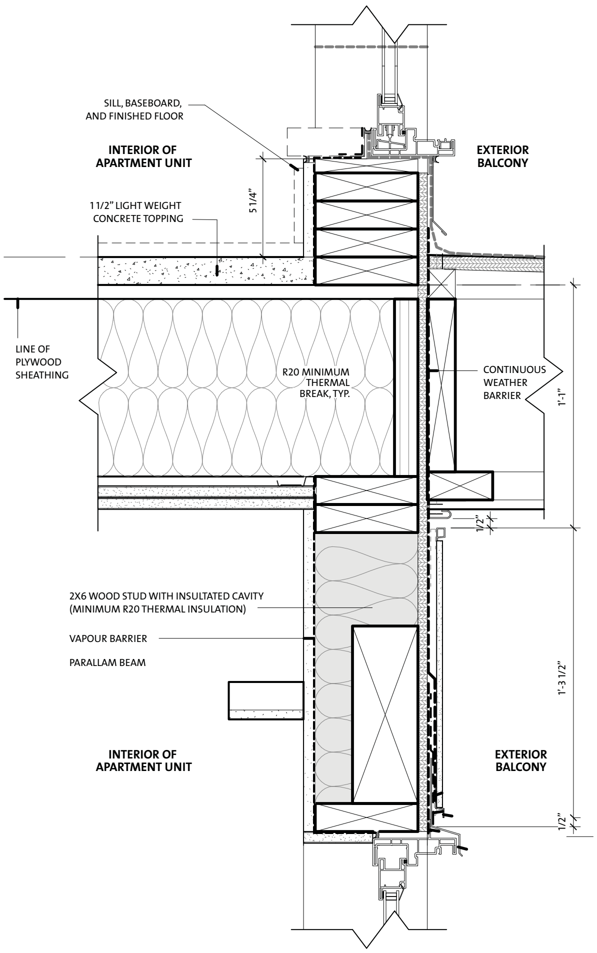


FIGURE 03

Riverport Flats R5: This project employs the platform-frame system in which the floor joists sit on the double top plates of both exterior and interior walls. The detail shows how the structure for the exterior balcony is framed.

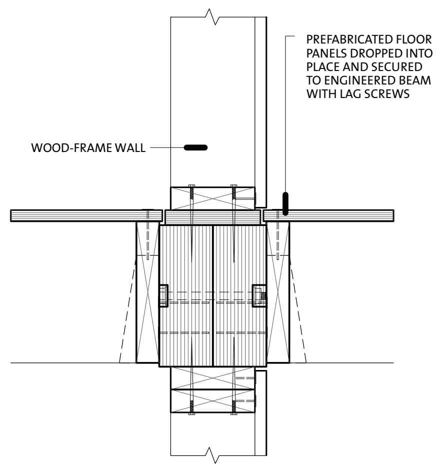


FIGURE 04

Hillcrest Village: A section through an interior wall showing a modified or balloon-frame system. Vertical shrinkage in the wall is minimized using an engineered wood beam at each floor level. The floors themselves are prefabricated using solid sawn lumber, then dropped into place and secured to the beams.

Construction of Library Square, Kamloops, B.C.

Both Riverport Flats R5 and Library Square use wood I-joists or engineered wood beams for the floor structure and kiln dried lumber for the bottom and top plates. For reasons of cost, the Hillcrest design team used dimension lumber for all floor joists except on the ground floor. This would normally result in significant accumulated shrinkage throughout the height of the building. In this case, however, the team worked with the company prefabricating the floor panels to devise a modified balloon-framing system which incorporated beam and hanger detail that allows panels to be dropped into place by crane and hung off the engineered wood beams built into the bearing walls.

Another related consideration is differential movement between the wood framing and other structural or finish materials. Steel, concrete and brick continue to expand and contract due to temperature changes, while wood generally maintains its dimensions having reached its EMC. In a mid-rise wood building, differential movement is likely to occur where wood-frame construction meets a concrete stair or elevator shaft or a fire wall built from concrete masonry, and around plumbing, electrical and mechanical systems.

As stair and elevator shafts are an important part of a project's lateral design, the choice of material generally comes down to the structural engineer's preference. Cotter Architects Inc. has experience with both concrete elevator shafts and shafts built from nail laminated 2x6 lumber. For concrete shafts, the team designed a 'slip joint' and adjustable threshold detail to accommodate any differential movement that might occur between the concrete and wood construction. With a wood shaft, this detail is not required, but attention must be paid to even the smallest misalignment of the vertical guideways to ensure a properly functioning elevator.

Partially constructed central stairwell (top) and elevator shaft (bottom) at Hillcrest Village, Fort St. John, B.C.

Construction of Riverport Flats R5, Richmond, B.C.

On-site fabrication of floor panels, Hillcrest Village, Fort St. John, B.C.

PREFABRICATION

With six-storey wood buildings, some level of prefabrication, either on-site or off, is common—from complete wall, floor and roof assemblies to components such as trusses or I-joists. One reason is quality control and the fact that manufacturing tolerances can often be made tighter than in field construction.

For example, the millimetre differences in stud length that can occur when framing a wall on-site can result in inefficient transfer of vertical loads and deformations within the structure. While there is leeway for this in smaller buildings, these differences can accumulate to an unacceptable level when multiplied over six storeys.

Sophisticated prefabrication operations can also be used to optimize material use, reduce waste and centralize recycling of lumber off-cuts. Prefabrication also speeds construction by enabling framing to start in the shop while foundations and other concrete work are being done on site. It can also offer the advantage of 'just in time' delivery of components, meaning that site storage of materials can be kept to a minimum.

The Riverport Flats R5 team used factory prefabricated floor, wall and roof panels, where Ardea, Herons Landing and Sail Phase 2 employed site prefabrication. Hillcrest factory prefabricated the wall panels and site prefabricated the floor panels which arguably required less precision because of the modified balloon-frame method of construction.

For the Sail project, site prefabrication was carried out in a temporary shop with a sawyer's bench under the supervision of a master carpenter. Floor and wall panels were fabricated a day or two ahead of construction to minimize the need to store materials on a relatively restricted site, then craned into place when required. Floor panels varied in size; wall panels were generally 5m in length. As each floor was completed, the elevation of the finished floor was taken and compared to the design drawings. If necessary, the height of the next set of wall panels was adjusted accordingly. This method ensured that there was no accumulation of errors as work progressed. On this project, prefabrication was adopted as much for efficiency and cost as quality control.

FIRE PERFORMANCE AND OCCUPANT SAFETY

Building codes set minimum performance requirements related to safety, health, accessibility and structural performance for all new building construction. This focus on results means that wood buildings must meet the same code objectives and functional requirements as buildings made from any other structural material.

Among the requirements of the revised B.C. building code,[7] mid-rise buildings more than four storeys must be fully sprinklered to National Fire Protection Association (NFPA) 13 standards. Exterior cladding must now also be made from non-combustible materials, which includes fire retardant-treated wood. While the cladding materials specified for the featured projects offered the advantage of light weight, they also met additional requirements related to reducing the risk of flame spread.

This requirement applies to the exterior layer of the wall construction only, which means that combustible trim and soffits are permitted. (These elements are not considered part of the building envelope.) Where there is a desire to use wood for decorative purposes in other areas, members must be tested to confirm they meet requirements for heavy timber, which is permitted in exterior applications.

Where solid wood elevator and stair shafts are used, they must be covered in fire-rated plywood roof sheathing. Within the building, the fire rating and flame spread requirements are the same as they are in four-storey construction.

All of the projects described in this publication used a proprietary firewall system of one kind or another. These systems generally incorporate two separate wood-frame walls on either side of a steel channel gypsum firewall. If consumed by fire, these outer walls are designed to collapse without compromising the integrity of the rest of the firewall.

7 For a complete explanation of changes, see: http://www.housing.gov.bc.ca/building/wood_frame/6storey_form.htm

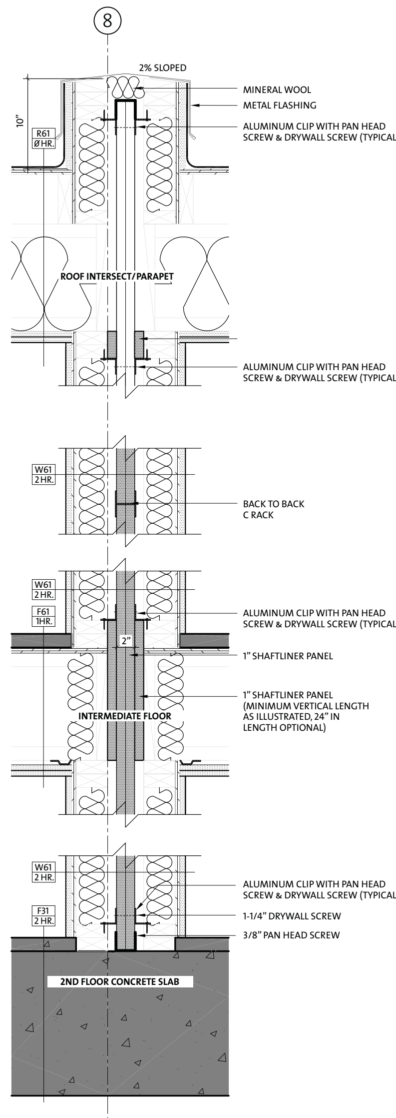


FIGURE 05

Riverport Flats R5: The project uses a proprietary firewall system in which two freestanding walls are tied together. If one side collapses due to fire, the other is designed to remain intact.

ACOUSTIC PERFORMANCE

As with any issue of building performance, the acoustics of a mixed-use wood-frame structure can be designed to meet or exceed minimal requirements, depending on the expectations of the developer, buyers and tenants.

Acoustic performance at vertical separations can be achieved using staggered studs mounted on a single 2x6 sill plate, with a double layer of drywall on either side. Another option is the use of a double stud wall system with a 25mm air gap. Acoustic performance at horizontal separations can be achieved using a concrete topping that may vary from as little as 25mm of lightweight gypcrete, to 75mm of similar material.

The choice of topping thickness is related to cost and performance, as well as the choice of heating system. Radiant piping can be installed in toppings of 38mm or more in depth. The depth of topping also affects the sill plate detail on all perimeter walls. At Hillcrest Village, no topping was used. Instead, for reasons of economy and weight, a resilient layer was installed below the floor finish and the ceilings were constructed using a double layer of drywall on resilient channels that inhibit the transfer of impact noise.

Hillcrest Village: Rendering of the building cross section

CONSIDERATIONS DURING CONSTRUCTION

While discussion of six-storey wood buildings tends to focus on structural performance and occupant safety, there are also issues to consider related to construction.

WEATHER AND MOISTURE PROTECTION

It stands to reason that a six-storey wood building will take approximately 50% longer to frame than a four-storey equivalent built using the same techniques. As such, the risk of materials getting wet is considerably greater. This situation is exacerbated by the increased number of laminated solid sawn members that are required to carry the increased loads on the lower floors. If exposed to weather, these have a tendency to retain water longer than non-laminated members.

On the Sail project, the contractor monitored water exposure and retention to ensure proper drying. Holes were drilled through the concrete topping and subfloor on each level to allow water to drip into buckets rather than forming ponds that might prolong exposure to the wood. For the lowest floor, which was also the roof of the parking garage, a 38mm concrete upstand was created to accomplish the same objective.

FIRE SAFETY

While there have been more than 50 five- and six-storey wood-frame buildings completed in B.C. over the last five years, many municipal building officials and fire safety officers have not yet had firsthand experience with the application.

In the case of Sail, which was the first six-storey wood-frame building constructed in Vancouver, the design team met with the authority having jurisdiction well in advance of the project to ensure that everyone was comfortable with the proposed approach.

Recognizing the vulnerability of wood-frame buildings to fire while under construction, Sail's developer, Adera, created a protocol that has since been adopted by other municipalities. Safety measures included having running water available on site for firefighting throughout the construction period, and installing gypsum board from the ground floor up rather than the reverse, which has always been the standard practice.

At the request of the fire department, one of the exit stairways in each building discharges directly to the street, both for the added safety of occupants and to improve access for firefighters. The fire department was invited to visit the site monthly to review safety procedures.

SITE LOGISTICS

In terms of construction site logistics, scaling up from four to six storeys takes wood-frame construction to a similar level of complexity as high-rise construction. For example, prefabrication generally requires the use of a crane, and tight scheduling of trade activities is critical for economy and efficiency. At Herons Landing and Sail, cranes were positioned between the phase 1 and 2 buildings for maximum efficiency. Panel prefabrication must also be timed so erection can proceed smoothly and the needs of other trades are accommodated.

Construction of Library Square, Kamloops, B.C.

CONCLUSION

THE FIVE PROJECTS DESCRIBED IN THIS PUBLICATION EXEMPLIFY different approaches that can be taken to address the technical challenges posed by mid-rise wood-frame design and construction; approaches that to some degree reflect the preferences of the architect, structural engineer, developer or contractor, but also variations in market conditions across the province.

In the case of Hillcrest Village, wood-frame construction allowed the team to deliver the Phase 1 building at a cost of approximately $1300/m², making the project viable in a market where rents are low. This has been achieved despite difficult site conditions that required unusually complex foundations. In this instance, the lightness of the wood structure and an alternative solution to the conventional concrete topping for horizontal acoustic separation contributed to a successful project.

On Vancouver Island, the Ardea and Herons Landing project has also proven that mid-rise wood-frame applications are capable of delivering a successful product into a rental market that has been stagnant for 25 years.

In the City of Richmond, another municipality with soft soil conditions, six-storey wood-frame construction has proven popular with developers because of its reduced foundation costs relative to those for concrete structures. Some have been built directly on a floor slab, and others—such as Riverport Flats R5—with a retail or commercial podium. Their success extends across a range of market sectors including both rental buildings and market condominiums.

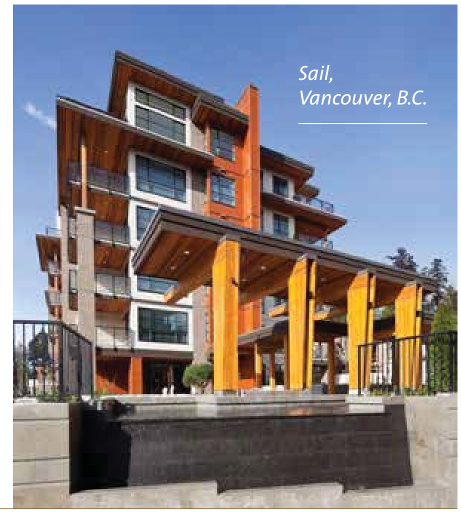
In Vancouver, the Sail project, built in a desirable west side neighbourhood, has demonstrated that a six-storey wood-frame project can be successful in a competitive market where the mid-rise norm is concrete. According to the architect, the team saved 20-25% by specifying wood instead of concrete, while completing the building more quickly. Wood also allowed them to meet advanced environmental goals, with the project achieving REAP Platinum certification, which is the highest designation available through the University of British Columbia's Residential Environmental Assessment Program.

In Kamloops, Library Square perhaps best epitomizes the broader benefits to be realized through mid-rise wood-frame construction. In the heart of the city's North Shore neighbourhood, it brings cultural, commercial and residential facilities together in a mixed-use building that is close to shopping, restaurants, parks and transit, all of which reduce residents' dependence on private automobiles.

As the number of five- and six-storey wood-frame projects increases across B.C., 'best practice' standards will emerge in response to local market conditions. Already these buildings—with their locally sourced renewable B.C. wood, their cost-competitiveness and their low carbon footprint—are contributing to a new range of housing options, to the health of local economies and to the sustainability of communities throughout the province.

Riverport Flats R5,
Richmond, B.C.

FRAME



PROJECT CREDITS

ARDEA AND HERONS LANDING

CLIENT
E Y Properties

ARCHITECT
KPL James Architecture

STRUCTURAL ENGINEER
Read Jones Christoffersen

GENERAL CONTRACTOR
Farmer Construction

SPECIALIST WOOD CONTRACTOR
Westco Construction

PHOTOGRAPHER
KPL James Architecture

SAIL

CLIENT
Adera

ARCHITECT
Rositch Hemphill Architects

STRUCTURAL ENGINEER
Weiler Smith Bowers

PROJECT MANAGER
Adera

GENERAL CONTRACTOR
Adera

SPECIALIST WOOD CONTRACTOR
Blackline Construction (Building Framing), Structurlam Products (Entry Canopy)

PHOTOGRAPHER
Raef Grohne Architectural Photographer

RIVERPORT FLATS R5

CLIENT
Brenhill Developments

ARCHITECT
Cotter Architects Inc.

STRUCTURAL ENGINEER
Weiler Smith Bowers

PROJECT MANAGER
CounterPoint Communications Inc.

GENERAL CONTRACTOR
Metro-Can Construction Ltd.

FINISHING CARPENTRY
Westbang Construction Ltd.

FRAMING
Mitsui Homes Canada Inc.

PHOTOGRAPHER
Cotter Architects Inc.
John Bentley

LIBRARY SQUARE

CLIENT
Total Concept Developments
Mr. Casey VanDongen

ARCHITECT
JM Architecture Inc.

STRUCTURAL ENGINEER
John Siefken Structural Engineering Ltd.

PROJECT MANAGER
Tri City Contracting

GENERAL CONTRACTOR
Tri City Contracting

PHOTOGRAPHER
JM Architecture Inc.
Martin Knowles

HILLCREST VILLAGE

OWNER/DEVELOPER
Cape Construction

ARCHITECT
MGA | Michael Green Architecture

STRUCTURAL ENGINEER
Read Jones Christoffersen

GENERAL CONTRACTOR
Cape Construction

SPECIALIST WOOD CONTRACTOR
Mitsui Homes Canada Inc.

PHOTOGRAPHY & RENDERINGS
MGA | Michael Green Architecture

FOR TECHNICAL INQUIRIES
www.wood-works.ca
1-877-929-9663