MEC Flagship Store

Vancouver, BC

Fast + Epp Home Office

Vancouver, BC

PH1

North Vancouver, BC

Low-Rise Commercial Buildings

A CASE STUDY

WoodWORKS! A Canadian Wood Council Program

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1.0 INTRODUCTION

Structural wood products offer viable and innovative solutions for low-rise commercial buildings. Compared with concrete and steel construction, the benefits of building with wood are substantial and far-reaching, and include reduced carbon impacts, accelerated speed of construction and enhanced building performance. As the three projects in this case study testify, building and design professionals have clearly embraced mass timber and technologically advanced wood systems as a new paradigm.

The MEC Flagship Store in Vancouver (Figure 1.1) uses a cross-laminated timber (CLT) and glulam structure as part of a holistic approach to sustainable design, which embodies the corporate values of the client; the Fast + Epp Home Office in Vancouver (Figure 1.2) also uses CLT and glulam in an elegant and economical solution that reflects the design philosophy of one of Canada's leading structural engineering practices; while PH1 on 1 Lonsdale Avenue in North Vancouver (Figure 1.3), a small restaurant and office project, finds solutions to some significant technical and logistical challenges through the use of off-site fabrication and virtual construction (the use of 4D modelling to optimize the construction sequence and delivery schedule for building components).

1.1: MEC Flagship Store: Entrance façade at dusk

1.2: Fast + Epp Home Office: View from southwest

1.3: PH1: South elevation to Carrie Cates Court

2.1 MEC Flagship Store: View from southwest

2.0 MEC FLAGSHIP STORE

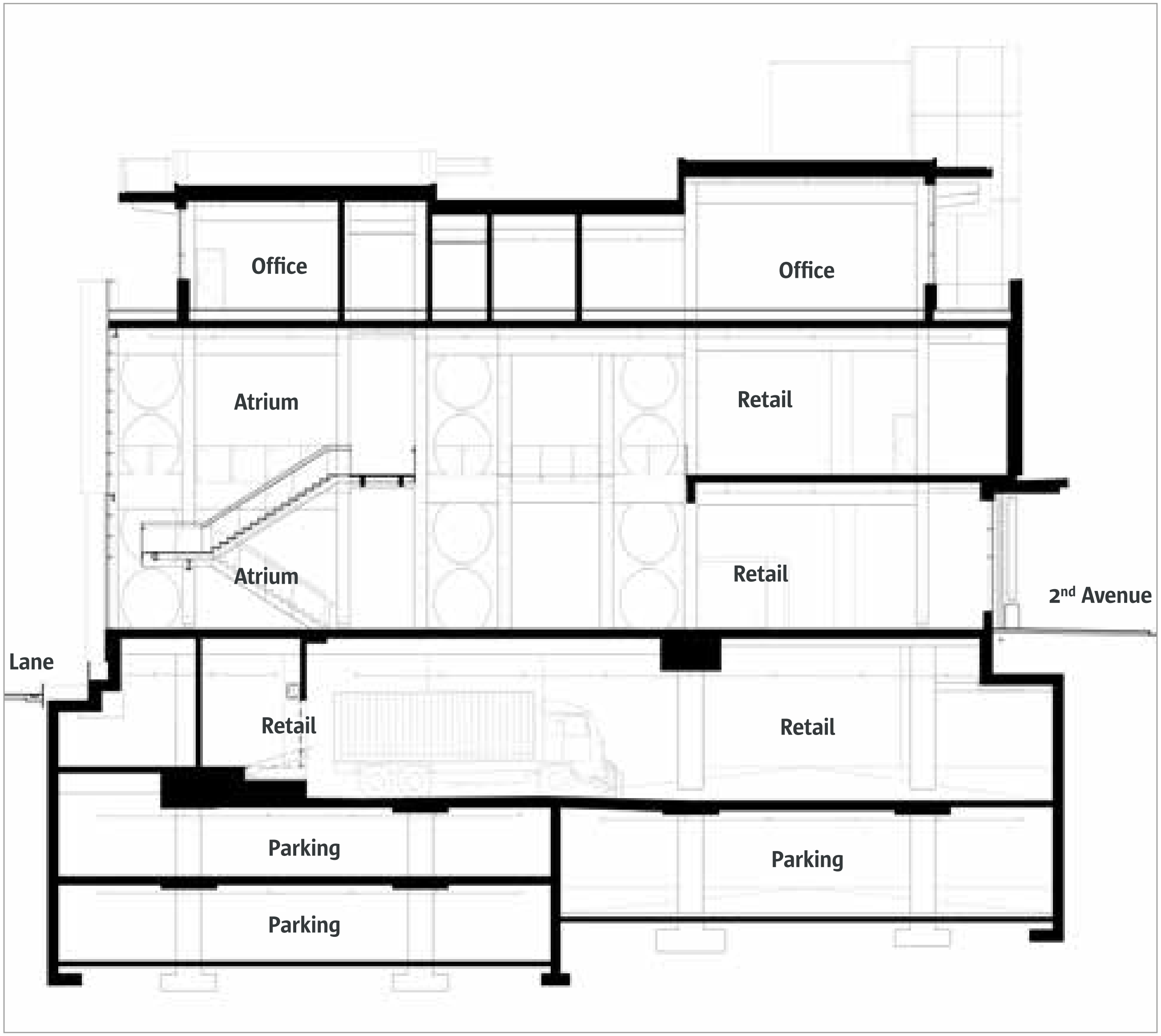
Vancouver, BC

Established in the 1970s, Vancouver-based Mountain Equipment Co-op (now MEC) has grown to become Canada's premier outdoor equipment retailer. Rapid expansion during the 2010s included the construction of a new store in North Vancouver (2013) and the company's head office in Vancouver (2014), both designed by Proscenium Architecture and showcasing wood construction and other green design strategies. Both projects were recognized with Canadian Green Building Awards.

After the completion of the North Vancouver store, MEC retained Proscenium Architecture again, together with Aedifica Architecture + Design of Montreal to undertake a rebranding exercise that would unify the character of future stores, both in terms of structure and interior design. The Vancouver store featured here embodies that new approach. MEC's commitment to environmental sustainability, consistent with the values of its customers, is also very much in evidence.

2.1 Architecture

As its flagship store in the company's home town, MEC wanted this one to be special. The location is at the intersection of 2nd Avenue and Quebec Street, marking the southeast corner of Vancouver's Olympic Village neighbourhood. Counter to the prevailing trend, the client and architect wanted to down-zone the site, so the store itself would be highly visible, rather than being integrated into the podium of a high-rise structure. The City agreed, based on its desire to create a southern 'gateway' to Olympic Village. One consequence of the down-zoning was that the roof of the store would be highly visible from the surrounding residential towers and should therefore be designed with the same consideration as the street elevations (Figure 2.1).



2.2: MEC Flagship Store: North-south section

The new building is a striking mass timber and glass structure with three storeys (two retail and one office) above ground with a total floor area of 5,730 square metres (61,677 square feet) and a three-level basement parking garage below grade (Figure 2.2). Because the lane at the north side of the building is considered a secondary street and has townhouses facing onto it, below-ground loading was also required.

The store entrance is on the south side, beneath a projecting CLT canopy that extends the length of the building. The canopy is supported on paired glulam columns lifted off the sidewalk on concrete plinths for protection against weather (Figure 2.3). At ground level, the south and west elevations facing the street are predominantly storefront glazing, in keeping with the City's desire that this be a transparent and engaging 'gateway' building whose presence enriches the pedestrian experience (Figure 2.4). This inverts the traditional inwardly focused approach to big-box retail design, in which walls are opaque and used internally for shelving and displays (Figure 2.5).

On the upper retail level, the south elevation is split by the glazed atrium, while the west elevation features an ombre wall system, on which the array of small bent metal discs displays a pixelated image of British Columbia's Freshfield Icefield in the Rocky Mountains by local outdoor photographer Jordan Manley.

Adjacent to this image, a wide Corten steel scupper creates a water feature, guiding water from the green roof into a Corten-clad bioswale planter at street level (Figure 2.6). This bioswale filters the water before discharging it to the storm sewer and nearby False Creek. This elevational treatment continues round the corner of the building into the lane. Rather than a traditional 'back-of-house' treatment, this lane is lined with stepping Corten planters and a trellis for climbing plants; the continuous siding is broken by double-height glazing that provides views into the interior atrium (Figure 2.7); and the service area at the entrance to the parking garage is lined with murals.

2.3: MEC Flagship Store: Canopy at main entrance

2.4: MEC Flagship Store: A beacon at the entrance to the Olympic Village Neighbourhood

2.5: MEC Flagship Store: Interior view of ground floor showing storefront glazing

2.6: MEC Flagship Store: West elevation showing scupper and bio-swale planters

2.7: MEC Flagship Store: Laneway elevation showing glazed atrium

2.8: MEC Flagship Store: Interior of atrium

The interior of the store is bright and airy, extending out to either side of the central daylit atrium (Figure 2.8). The glulam column-and-beam structural system with CLT floors is all visible, with mechanical and electrical services exposed. A grand, wax finished steel staircase connects the floors, while elegant, storey-height steel bracing elements, forming a circle large enough to walk through, contribute to the lateral system (Figure 2.9). The overall effect is industrial – softened by the warm tones of the CLT display systems and the colourful products they showcase.

The atrium creates an interconnected floor space that requires both sprinklers and a draft curtain to delay the upward movement of smoke generated by a fire on the lower floor. Rather than using the familiar glass curtains, the glulam beams at either end of the atrium were increased in depth to match that of the longitudinal beams, creating the continuous barrier required by the BC Building Code as a smoke curtain or draft stop. The large size of the atrium necessitated an alternative solution; as did the proprietary firestop system used to seal penetrations through the CLT structure.

The third-floor office space has a smaller footprint than the retail floors, with the setback from the building perimeter creating the opportunity for areas of green and blue roof. The roof captures rainwater that funnels into an underground cistern to provide up to 80% of the water used for flushing toilets.

On this third level the wood structure remains exposed, but the building services are run within a raised floor system finished with concrete tiles.

2.9: MEC Flagship Store: Pre-occupancy view of atrium showing omega bracing

Other sustainable design features of the project include:

- Connection to the Neighbourhood Energy Utility (NEU), which recovers heat from untreated urban wastewater. However, the superior energy performance of the MEC Flagship Store makes it a net contributor to the system.
- Energy consumption that is 30% less than the standards set out by the Model National Energy Code for Buildings (MNECB 2011).
- High-efficiency heating and cooling systems, combined with a high-performance building envelope that achieves R-50 for the roof and R-40 for the walls, providing the largest savings.
- Bicycle parking and electric vehicle charging stations.

The building has achieved LEED gold certification, and has also been recognized by Salmon-Safe, a program that promotes eco-friendly water management practices that protect salmon habitat and enhance urban ecosystems.

2.2 Structure

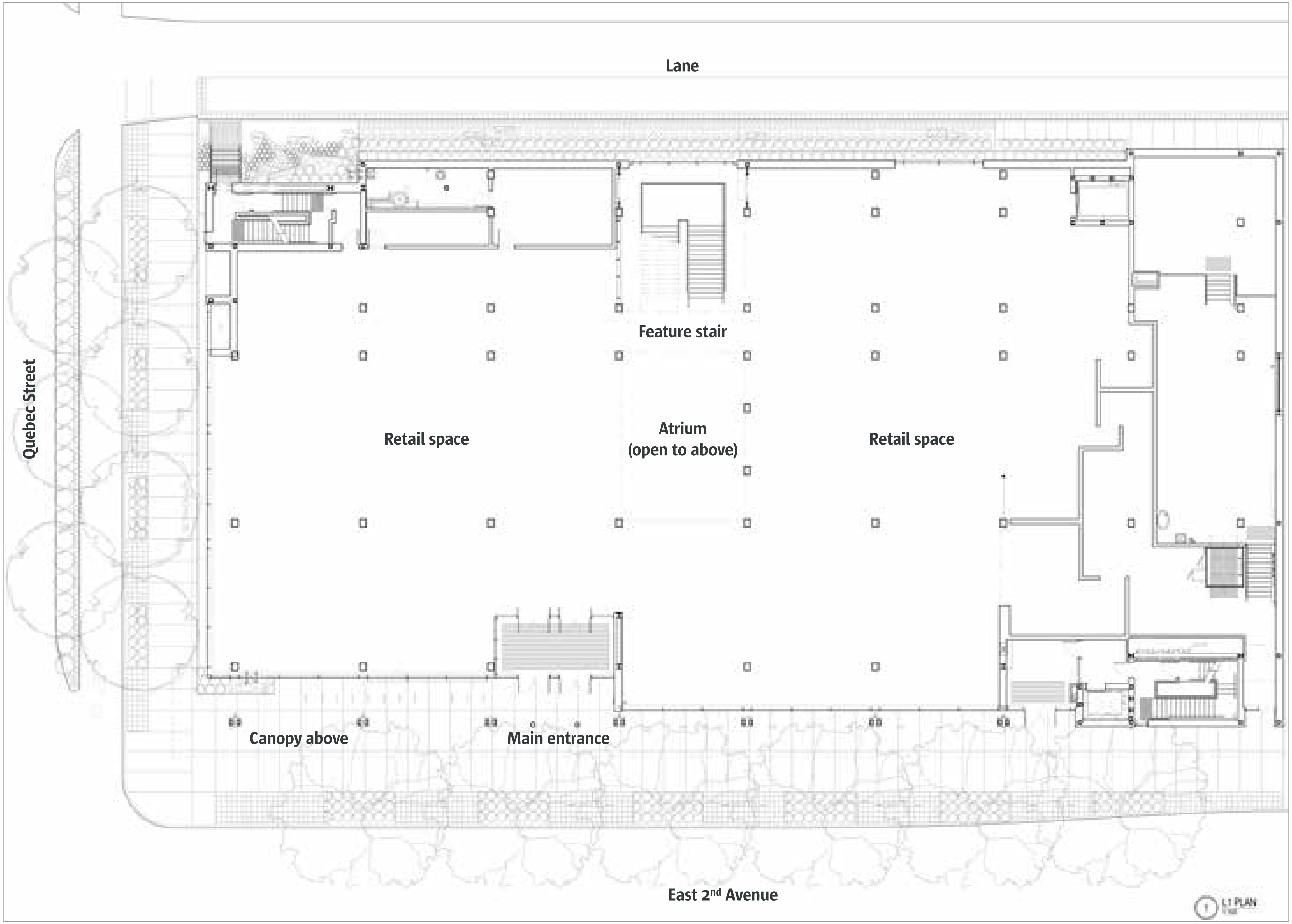
The site is a rectangle, approximately 62 metres (203 feet) in width (east to west) and 36 metres (118 feet) in depth (north to south) and flanked by 2nd Avenue on the south side and Quebec Street on the west. The three storeys of underground parking are of concrete construction, with the 275-millimetre (10.8 inches)- thick roof slab serving as the ground floor structure for the three-storey mass timber building above.

The gravity system consists of a glulam post-and-beam frame, with CLT floor panels spanning between beams. While the structural grid for the retail floors is rectangular and most often measures 7.5 metres (24.6 feet) east to west, the spans vary considerably in the north-south direction. The longest is 8.4 metres (27.5 feet), requiring beams that are almost 1 metre (39 inches) in depth (Figure 2.10). The glulam columns vary in size, the largest being located around the atrium. With the requirement for a 45-minute fire resistance rating, all the structural glulam elements are oversized to include a 'sacrificial (char) layer' of approximately 30 millimetres on each exposed surface, protecting the integrity of the structural section within.

The posts are storey height, with the beams connecting to the vertical faces (Figure 2.11). This enables the bottom of the upper floor posts to bear directly on the posts below, eliminating cross-grain material from the vertical load path and minimizing the effects of shrinkage. The connections between upper and lower posts are made using embedded steel rods glued in place with epoxy. Post-to-beam connections vary according to location. Where appearance is critical, concealed RICON SVS connectors are used. These steel connectors consist of two identical steel plates, one screwed into the face of the post, the other into the end of the beam. When brought together, they interlock to complete a concealed connection, protected from exposure to fire by the surrounding wood. In other locations, where the connections are not visible, more traditional steel-bearing plates have been used.

The floor consists of 7-layer, 245-millimetre (9.6 inches)-thick CLT panels laid in the east-west direction and typically spanning 7.5 metres (24.6 feet). The roof panels are also 7-ply as they are required to support the soil and plant material that make up the green roof. All the CLT panels and glulam elements were supplied by Structurlam from its plant in Penticton, BC.

The floor and roof panels bear directly on the beams and are secured by long stainless-steel screws. Plywood splines are used to bridge the joints between panels, enabling the floor system to act as a diaphragm and contribute to the overall lateral system in the building. The 25-millimetre (1 inch)- thick plywood splines are rabbeted into the top layer of the CLT and screwed in place to create a flush surface, as no concrete topping is used. The floor system connects to two steel stair cores in diagonally opposite corners of the building.



2.10: MEC Flagship Store: Ground floor plan

2.11: MEC Flagship Store: Under construction showing post-and-beam frame with CLT panel being prepared for installation

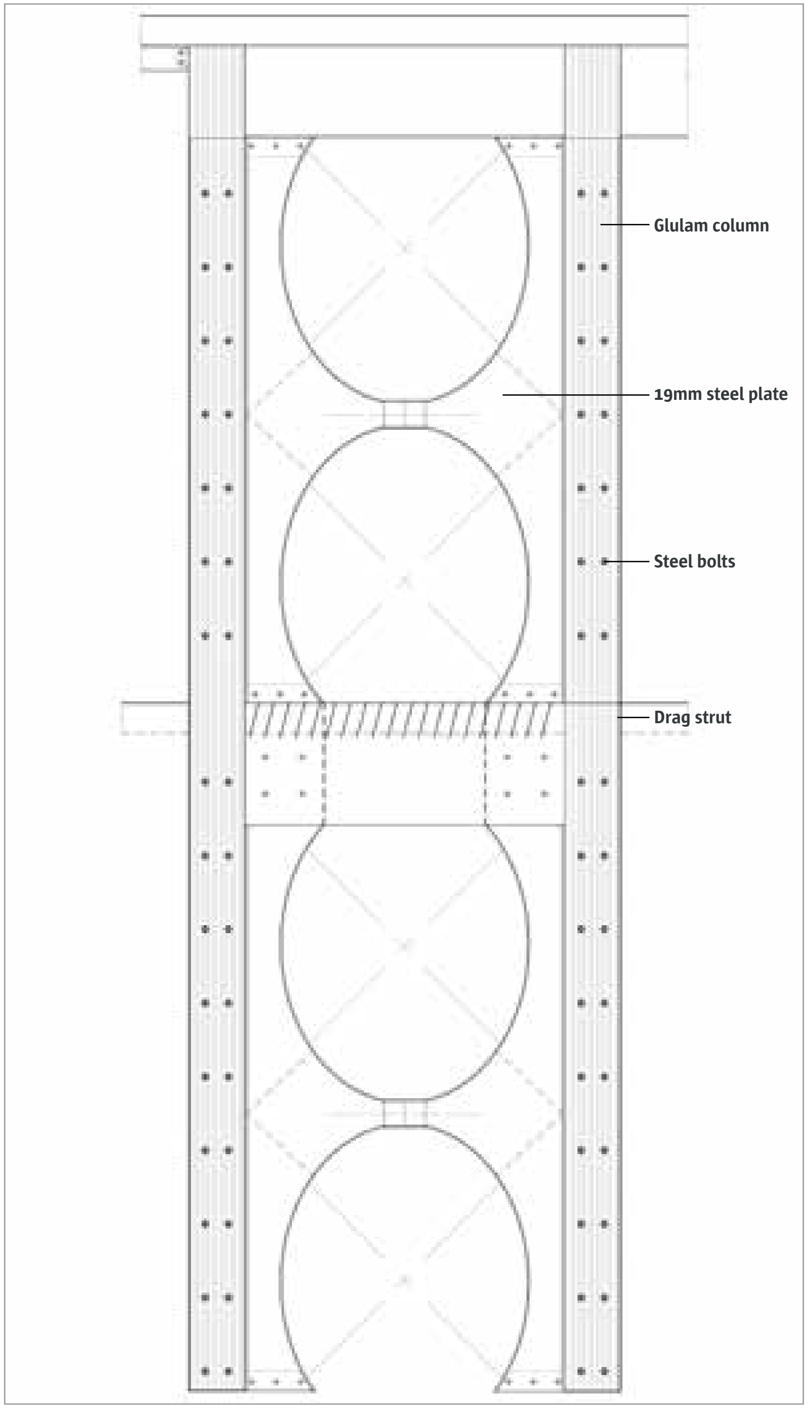
Other vertical elements contributing to the lateral stability of the building are concealed within partition walls. Buckling restraint braces are located in the east-west walls of the stair cores and where needed within walls running in the north-south direction. Where lateral bracing was needed and could not be concealed, exposed steel 'omega' bracing is used. These braces run vertically through the building and consist of two sculptural steel elements with a connection between them that provides the necessary ductility. A custom solution of a more traditional eccentrically braced frame, the name was coined by the design team because of the resemblance to the Greek letter Ω (Figure 2.12).

Detailed coordination was required between the structural engineer, architect and mechanical consultant, as there were several locations where sprinkler system piping had to be run through glulam beams. Generally, the strategy for integrating the building sprinkler system was to run the feed mains and cross mains along the narrower structural bays, particularly at the rear of the building, where the shallower beam depths enabled them to be partially concealed when viewed obliquely from below. Only the smaller diameter sprinkler system branch lines had to be run below the main beams.

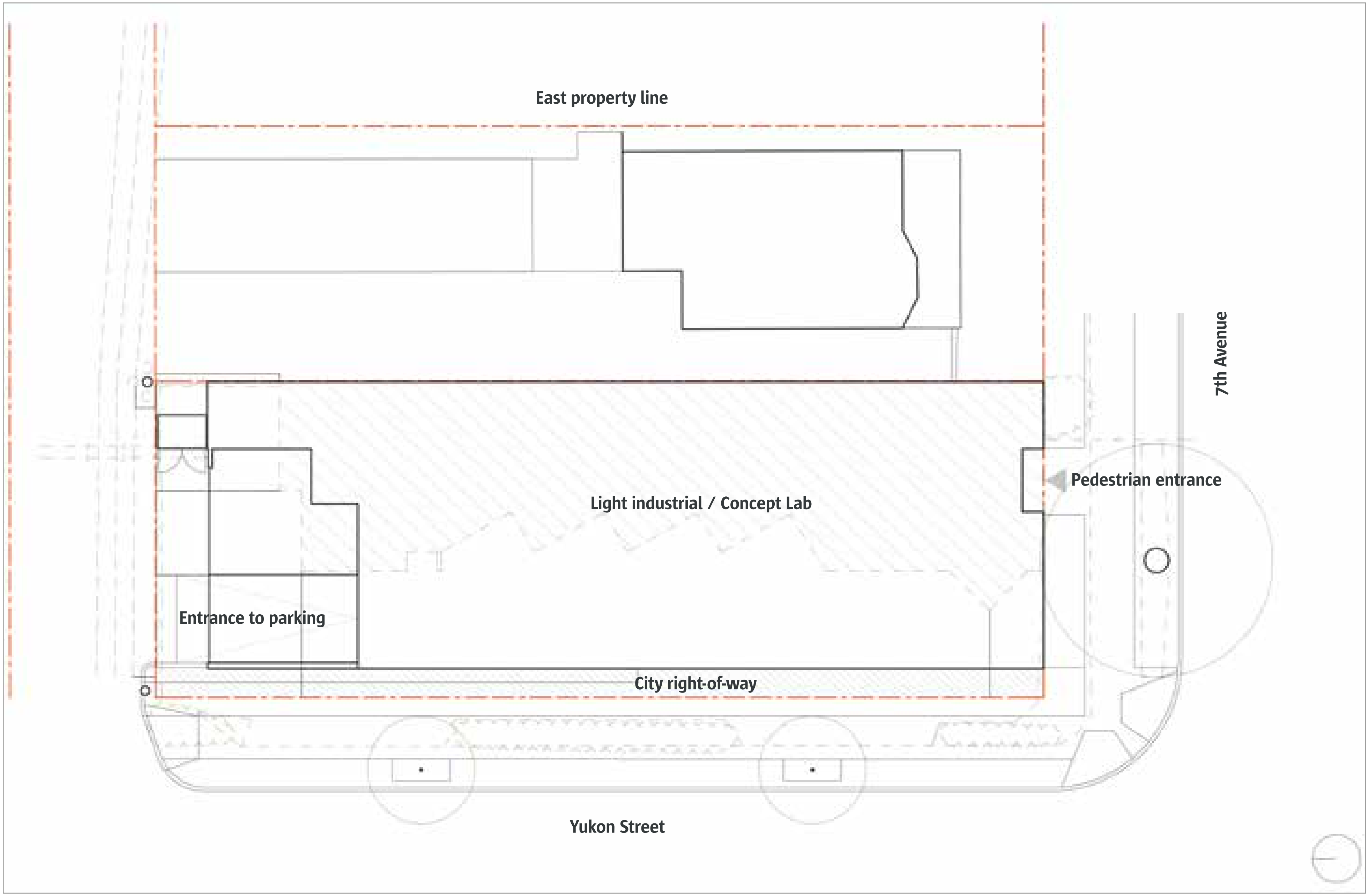
2.3 In Conclusion

The goal for this project was that it be a flagship store that captured the outdoor spirit and responded to environmental concerns of the MEC community.

> "With the proximity to cycling paths, the seawall running route and kayaking opportunities on False Creek, the store benefits from the energetic and active environment literally all around it. The architectural expression, with its sloping green roofs blurring the indoor-outdoor experience, tall wood structure and images of the mountains beyond speaks to MEC's outdoors spirit and acts as a perfect gateway to the neighbourhood."
>
> **Hugh Cochlin**
> *Proscenium Architecture*



2.12: MEC Flagship Store: Detail of omega bracing



3.1: Fast + Epp Office: Ground floor plan

3.0 FAST + EPP HOME OFFICE

Vancouver, BC

This four-storey mixed-use building is the new home for prominent Vancouver-based structural engineering firm, Fast + Epp. Close to downtown and a short walk from the major transit intersection at Cambie Street and Broadway Avenue, the 37 x 13.7-metre (121 x 45 feet) site is part of an eclectic light-industrial area that has been undergoing dramatic transformation over the past decade. Recent zoning changes have increased the permissible floor-space ratio (FSR) to 3.0, but maintained the requirement that light-industrial uses be located at ground level and occupy at least 1.0 FSR.

On this particular site, this requirement was complicated by the existence of a 1.2-metre (4 feet)-wide right-of-way for future road widening that runs along the west (Yukon Street) boundary (Figure 3.1). With allowable office FSR tied to the industrial FSR provided, it was necessary to locate a portion of the light-industrial space on the second floor, in order to achieve the maximum permitted density on the site.

Below ground, the site was so narrow that accommodating the car parking spaces and a drive aisle required the elimination of interior columns from the parking garage, in favour of a clear span post-tensioned concrete slab. This in turn influenced the design of the above ground structure, where clear spanning glulam beams informed both the subdivision of space and the routing of exposed building services (Figure 3.2).

3.1 Architecture

Initially, architects at f2a architecture sought a signature expression for the building that would exemplify the engineering expertise of Fast + Epp, however none of the ideas generated satisfied all of the core design goals. Instead, a decision was made to focus the design on features with greater returns – in particular greater connection to the exterior.

It became clear that the combination of site constraints required a particularly rigorous design response, leading to solutions that are simple, practical and economical in their use of space and materials. These objectives resonated, both with the philosophy of the client and with the ambitions of f2a architecture, which are to create buildings that are minimal, energy efficient, have healthy interiors and a direct relationship to their site (Figure 3.3).

3.2: Fast + Epp Office: View of post, beam and panel structure during construction

3.3: Fast + Epp Office: The final form of the building was a simple box, the rooftop penthouse having access to outdoor space

3.4: Fast + Epp Office: The 'Noble Box'

3.5: Fast + Epp Office: Interconnected floor space under construction

The architects refer to the final design as the 'Noble Box' (Figure 3.4), because of its simplicity and the high-quality environment it provides. The building has a simple rectangular form and a standard 3.05-metre (10 feet) structural bay, yet within this volume it has two rooftop patios providing employees with access to the exterior, an interconnected floor space that encourages social interaction, abundant daylight and ample fresh air. The loading bay is discreetly tucked away at the north end of the building, leaving the overall architectural expression elegant and uncluttered.

To maximize leasable area within the permissible FSR and building height, the ground level industrial space has a floor-to-floor height of 4.86 metres (16 feet); the second level has a floor-to-floor height of 3.6 metres (12 feet) and includes both light-industrial and office uses; the third level (also with a 3.6-metre floor-to-floor height) includes an atrium area interconnected with the fourth level, which adds a further 2.6 metres (8 feet, 8 inches) to the overall height.

The requirement to achieve 1.0 FSR of industrial space dictated partition locations and informed the structural module at the interconnected floor space (Figure 3.5). The City of Vancouver required a 2-hour fire separation between industrial and commercial occupancies, with 1 hour required for the other floors and supporting structure.

As noted, the atrium serves as a meeting area and social gathering space for the Fast + Epp office. To one side there is a small kitchen. The fourth floor accommodates 'touch down' work stations and (being smaller in plan area than the lower floors) has access

3.6: Fast + Epp Office: A deep glulam beam creates the required smoke curtain at the interconnected floor space

3.7: Fast + Epp Office: Horizontal services running below the glulam beam structure prior to being concealed in a bulkhead

3.8: Fast + Epp Office: South elevation with vertical stair tower (right) and curtain wall glazing (left) — overall window-to-wall ratio for the building is 40%

3.9: Fast + Epp Office: The electrochromic glazing automatically changes tint according to solar intensity

3.10: Fast + Epp Office: Tectonus seismic damper to a roof terrace. The two levels will be connected by a feature stair, scheduled for fabrication in Fast + Epp's 'Concept Lab' – an innovation and testing facility that will occupy the ground floor industrial space.

To realize the vision for this interconnected floor space, an alternative solution was required. The NFPA-compliant sprinkler water curtain was supplemented with automatic smoke vents, while the smoke curtain at the lower ceiling level was provided by the 600-millimetre (2 feet) depth of the glulam beams (Figure 3.6).

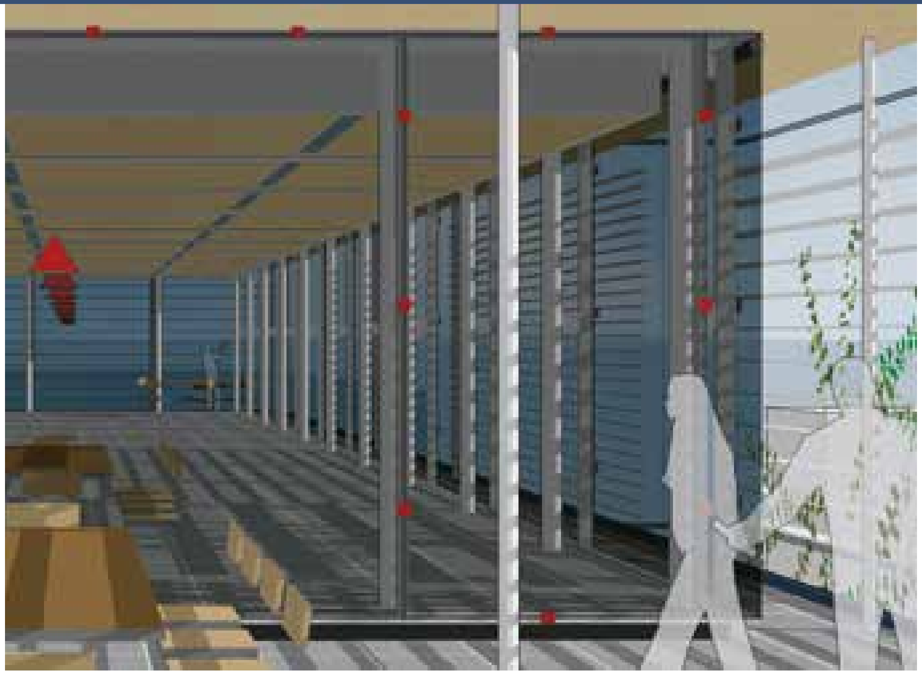
Egress stairs, elevators, and a vertical service shaft are located in the southeast and northeast corners of the building (adjacent to the lane). These shafts act as bookends to the north-south service zone that runs the length of the building. This zone includes washrooms and ancillary rooms, above which is a bulkhead containing the horizontal runs for power, water and fresh air ventilation services (Figure 3.7). This strategy permits the majority of north-south services to be run under the transverse glulam beams, rather than penetrating them. East-west electrical and mechanical services run in the spaces between these beams, so making them as unobtrusive as possible.

The east wall along the common property line is of solid CLT panel construction, supplied partly pre-clad with cladding clips and girts, external mineral wool insulation, with a vapour barrier membrane. Metal cladding was applied in the field. Much of the rest of the building is glazed, achieving a more than 40% glazing ratio through energy modelling (Figure 3.8).

On the south and west façades, electrochromic glass was used to provide protection from solar heat gain and glare without the legal and maintenance challenges of fixed shading that would encroach on the sidewalk right-of-way. This dynamic glass maximizes natural daylight and maintains views while controlling solar heat gain and unwanted glare. The glass will intelligently adjust tint throughout the day to optimize employee comfort and working conditions (Figure 3.9). Combined with natural ventilation and the elimination of interior blinds, this solution reduced overall energy demand and maintenance costs.

To further increase light and views to the exterior, the glulam beams are supported on the west side by steel (HSS) columns, which have a much smaller cross-section than glulam posts of equivalent strength. Fire protection for the steel is provided by intumescent paint, whereas exposed glulams would have required the addition of a significant sacrificial (char) layer. The slenderness of the 3-ply CLT floor panels and coordination with horizontal glazing bars also minimizes the impact of the structure on overall transparency when viewed from outside.

The expanse of glass on the west elevation is complemented by a vertical section of corrugated and perforated aluminum. This feature wall will be an illuminated 'light box' symbolizing the healthy mind. The connection between the building and the public will be greatest at sidewalk level where the Fast + Epp 'Concept Lab' will give passersby a taste of the hands-on work that is contributing to building innovation.



3.11: Fast + Epp Office: Rendering of penthouse interior

3.2 Structure

As noted above, the superstructure is built on top of the post-tensioned concrete slab that forms the roof of the parking garage. The entire east wall of the building consists of two-storey high, vertically oriented 5-ply CLT panels connected together at their vertical and horizontal joints using plywood splines screwed to the interior surfaces, or where the joints between panels are visible, a neater, half-lap connection is used. This wall is connected to the CLT stair shaft cores at the northeast and southeast corners of the building and has glulam pilasters integrated into it at 3.0-metre (10 feet) centres, corresponding to the structural bays. Because CLT is a combustible material and the wall is constructed on the property line, this assembly required the code consultant to write and submit an alternative solution to demonstrate an equivalent level of fire safety to the non-combustible construction mandated by the code.

Anchored by the stair shaft cores at either end, this composite CLT and glulam wall takes all the shear forces in the north-south direction. In the east-west direction, the CLT walls of the stair shaft cores have Tectonus proprietary seismic dampers recessed into them (Figure 3.10). Developed in New Zealand, these dampers are branded as Resilient Slip Friction Joint (RSFJ) and consist of two outer plates and two centre plates with elongated holes. The outer cap plates and the centre slotted plates are grooved and clamped together with high strength bolts and disc springs.

These devices hold down shear walls and dissipate seismic energy and are designed to minimize or prevent structural damage from moderate earthquakes. The devices enable the shearwalls to rock, then restore themselves to their original configuration without

3.12: Fast + Epp Office: The electrochromic glazing system combines ecology with technology

suffering plastic deformation. Through effective energy dissipation and the self-centering capability of the system, structures are able to withstand earthquake sequences without replacement of the devices or the need for potentially costly structural repairs.

While CLT shearwalls are codified, the Tectonus damper system is not and had to be covered by an engineering letter of assurance. Additional steel cross bracing is used in the east-west direction at the north of the building to counteract torsional forces.

The floors consist of 105-millimetre (4 inches)- thick 3-ply CLT panels that span 3 metres (10 feet) between the main glulam floor beams. The panels are attached to the beams using long stainless-steel screws, set at opposing 45-degree angles. The panels are then fastened together with 25-millimetre (1 inch)- thick plywood splines, nailed in place to create a floor diaphragm. The panels are covered with a 13-millimetre (0.5 inch) acoustic mat that also acts as a membrane to prevent moisture damage from the 50-millimetre (2 inches) concrete topping. The roof is also constructed using 3-ply CLT, although in this case, the panels are only 89 millimetres (3.5 inches) thick.

The steel columns that support the glulam beams at the west façade extend the full height of the building. They are coated in intumescent paint to achieve the 2-hour fire resistance required on the ground floor and 1-hour fire resistance required on all but the top floor above. Neither the roof, nor the structure supporting it are required to have a fire resistance rating, so on the penthouse level, no intumescent paint was used (Figure 3.11).

Steel chases that carry the cabling for the electrochromic glass are fastened to the glulam's outside column penetrations, acting as drag straps that tie the horizontal and vertical elements of the structure together.

3.3 In Conclusion

This project represents a new approach to the design of commercial buildings with its combination of panelized prefabrication, greater emphasis on non-toxic materials, and integrated digital technology (Figure 3.12).

> "... it is a step toward what American author John Greer refers to as the "Ecotechnic Future" – one that brings us simultaneously closer to both technology and nature."
>
> **Austin Hawkins**
> *f2a architecture*

4.0 PH1

North Vancouver, BC

This commercial infill project occupies a 7.62-metre (25 feet)- wide corner lot in the Lower Lonsdale district of North Vancouver. The east and west ends of the building face Lonsdale Avenue and a service lane respectively, while the north side abuts an adjacent property, and the south side faces across Carrie Cates Court to the new Polygon Gallery and the harbour beyond.

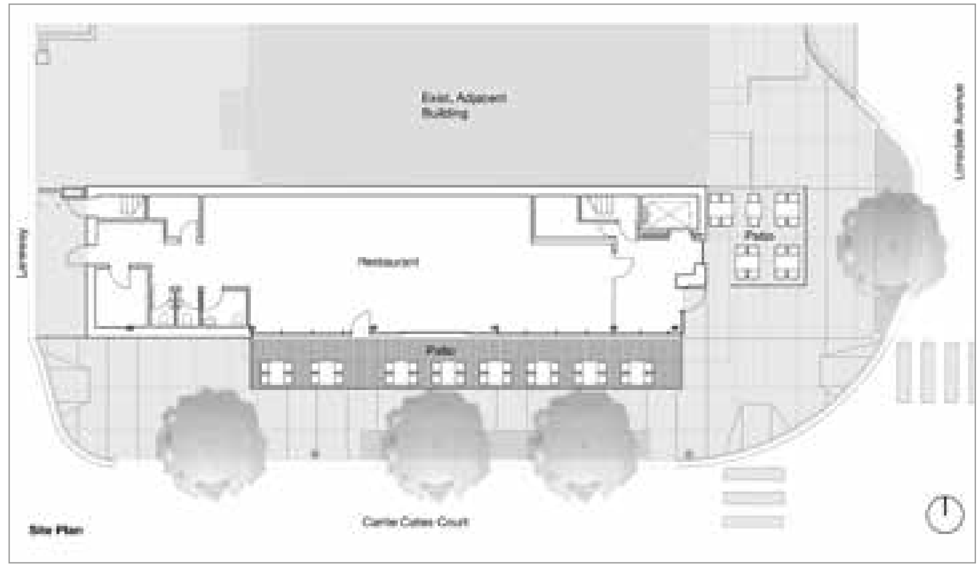
Originally an area of waterfront warehouses and marine service facilities, the neighbourhood has been transformed over time to a high density, mixed-use community centred on the Lonsdale Quay Market and Seabus Terminal. The consolidation of land required by the introduction of higher density zoning had left lots like this exceptionally difficult to develop.

As a family that had owned the property for three generations, the client was waiting for the right opportunity to do something special on the site. The idea of combining Passive House performance with modern mass timber construction was enthusiastically received, despite the many challenges and uncertainties it presented.

However, the first issue for Hemsworth Architecture was to resolve the zoning requirement for onsite parking on a lot that could not accommodate any. A traffic study was commissioned, demonstrating that the project would not result in increased traffic, even if no parking was provided. On this basis – and for the first time – the City of North Vancouver waived the parking requirement.

This made it possible to design a 690-square metre, three-storey building (with a ground floor restaurant and two storeys of offices above) that, with 92% site coverage, would achieve the full 2.53 FSR permitted by the zoning. The building made use of wall thickness exemptions (applicable to the extra thick walls used in Passive House construction) to achieve a three-storey building. At the same time, the site coverage eliminated the possibility of a staging area for materials and equipment that would typically be required to facilitate site construction (Figures 4.1 and 4.2).

The architect and structural engineer were confident that a mass timber structure could be prefabricated off site but, as far as they knew, there was no precedent for a prefabricated Passive House-compliant structure built on a shared property line – a situation that also required the wall to have a 1-hour fire resistance rating.



4.1 and 4.2: PH1: The small, Passive House-certified building occupies a tight site with a zero lot line condition and an existing structure to the north

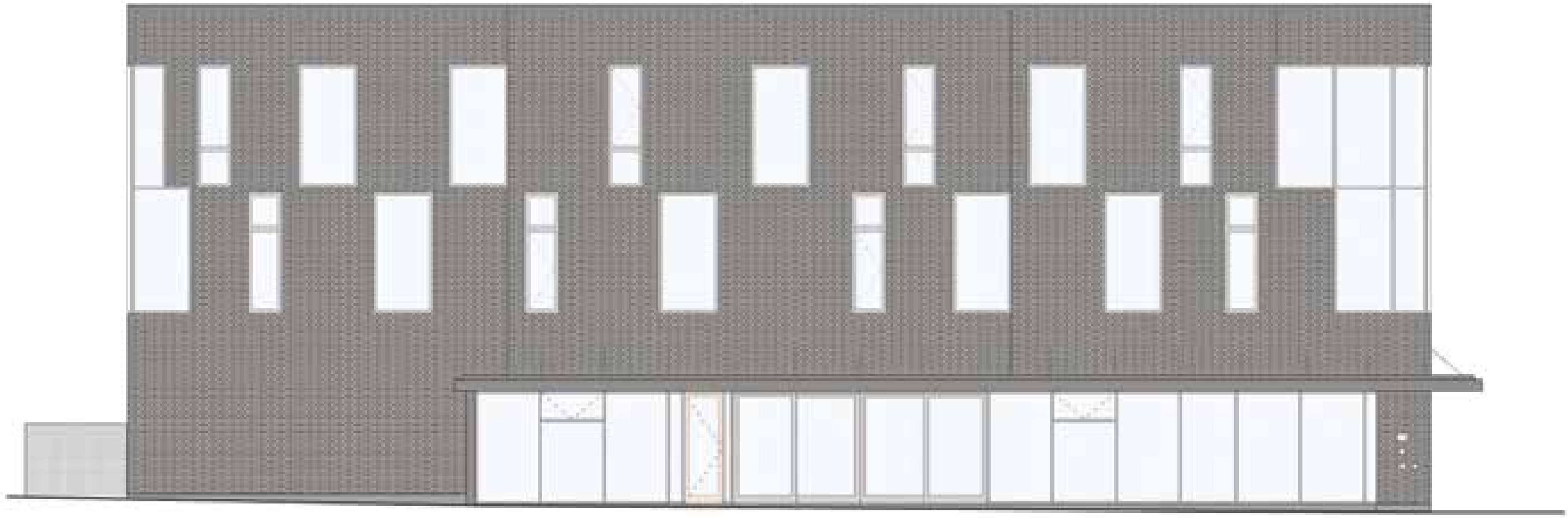
4.3 and 4.4: PH1: Located in a mid-rise commercial/residential neighbourhood, PH1 is across Carrie Cates Court from the Polygon Art Gallery and has oblique views to the harbour

4.1 Architecture

Architecturally, the concept was to use the traditional warehouse vocabulary of an exposed heavy timber structure with brick cladding, but to interpret it in a contemporary way. This strategy has translated into an exposed glulam post-and-beam structure with CLT floors, stair and elevator shafts.

Externally, the carefully articulated elevations respond to their immediate context. To this end, the non-loadbearing brick cladding at the southeast corner of the building is 'eroded' away and replaced with large areas of glazing that provide restaurant patrons and office workers with an oblique view to the harbour (Figures 4.3 and 4.4). The remainder of the south façade includes extensive glazing at ground level, with a staggered pattern of vertical windows on the upper floors.

The challenges associated with Passive House performance and certification were considerable. While the code permitted the three exterior walls facing the streets and lane to be of combustible construction, it required the north wall abutting the adjacent property to be constructed as a non-combustible firewall. Such walls are typically built block by block in concrete masonry, a method incompatible with Passive House performance. A more sophisticated solution was clearly required, one in which the continuous exterior insulation and vapour barrier essential for Passive House

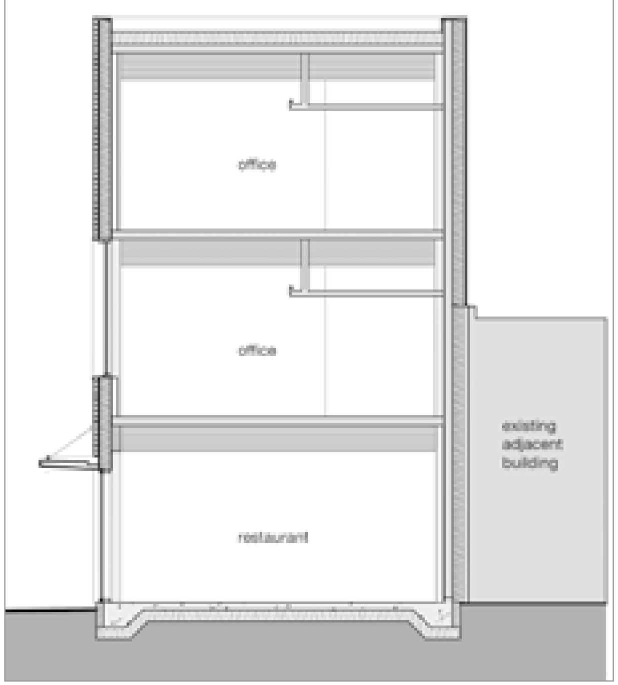


South elevation facing Carrie Cates Court

performance could be installed without accessing the outer face of the wall in the field.

Using an integrated design and construction process involving the architect, structural engineer, building envelope consultant, contractor, mass timber fabricator and installer, a prefabricated and pre-insulated wall system was devised. Alternative detailing, assembly and installation strategies were explored and optimized using virtual construction. As structural engineer Robert Malczyk of Equilibrium Consulting observed: *"On this project, we went way beyond the usual integrated design process, working alongside the crane operator, the window installers and other subcontractors, figuring out in a virtual model how best to build the building."* (Figures 4.5, 4.6 and 4.7).

The chosen wall system comprises full-height CLT panels, with a 75-millimetre-wide vertical rabbet cut into the inside face of both edges. The panels were laid flat and the air/vapour barrier applied to the outside surface,



East elevation facing Lonsdale Avenue

4.5, 4.6 and 4.7: PH1: South elevation to Carrie Cates Court, east elevation to Lonsdale Avenue and building cross-section

4.8: PH1: The building has a post-and-beam glulam frame with CLT floors and roof

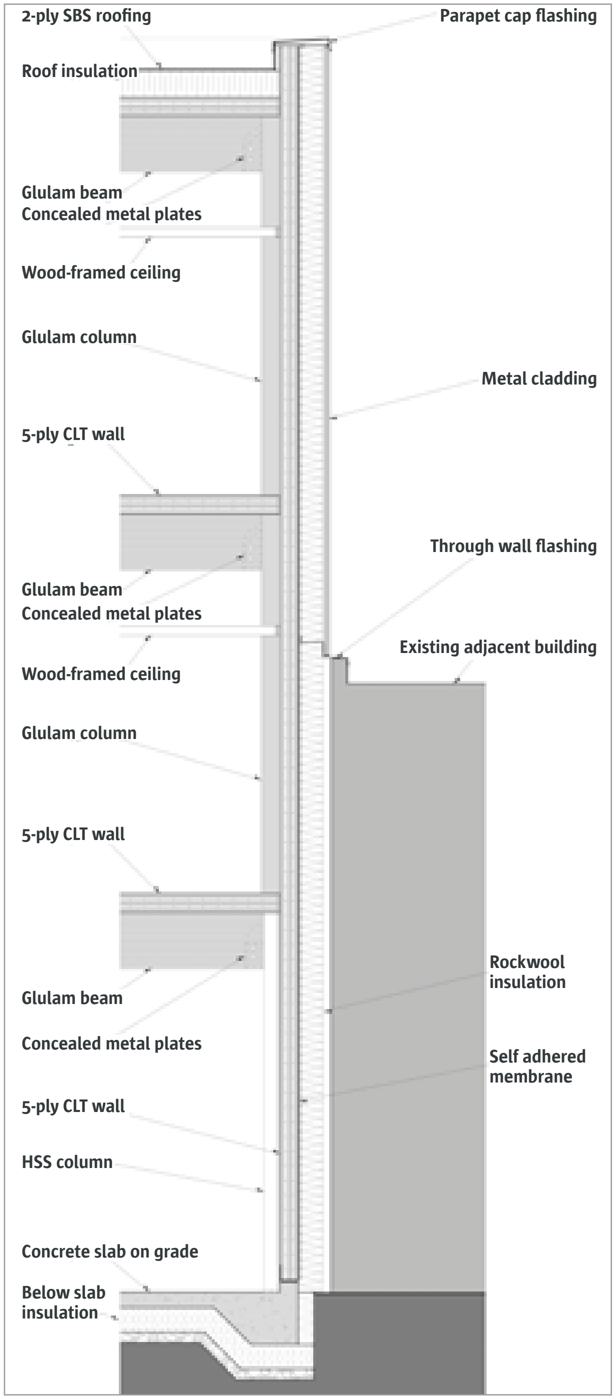
4.9: PH1: The gap between the existing building to the north and the new building

wrapped around the edges and into the rabbets on the inside face; then strapping and 200 millimetres (8 inches) of insulation were added.

As part of a carefully orchestrated construction sequence, the completed panels were lowered into place by crane between the adjacent masonry wall and the new post-and-beam structure (Figures 4.8, 4.9, 4.10 and 4.11). The vapour barrier was then completed from the inside by sealing the exposed ends (previously wrapped round the panel edges into the rabbeted surfaces) with a second layer of barrier material across the panel joints. Adjacent panels were connected structurally using a continuous plywood spline, set into the rebated joint and screwed in place. On the exterior, metal cladding was field installed on all parts of the wall not obstructed by the adjacent building (Figure 4.12). Being of combustible construction, this wall system required the code consultant to submit and certify an alternative solution to the Authority Having Jurisdiction.

4.10: PH1: The prefabricated CLT wall panels were lowered into the gap between the new and existing buildings

4.11: PH1: Once in place, the ends of the exterior vapour barrier, already wrapped round the edges of the panels, were sealed together from the inside

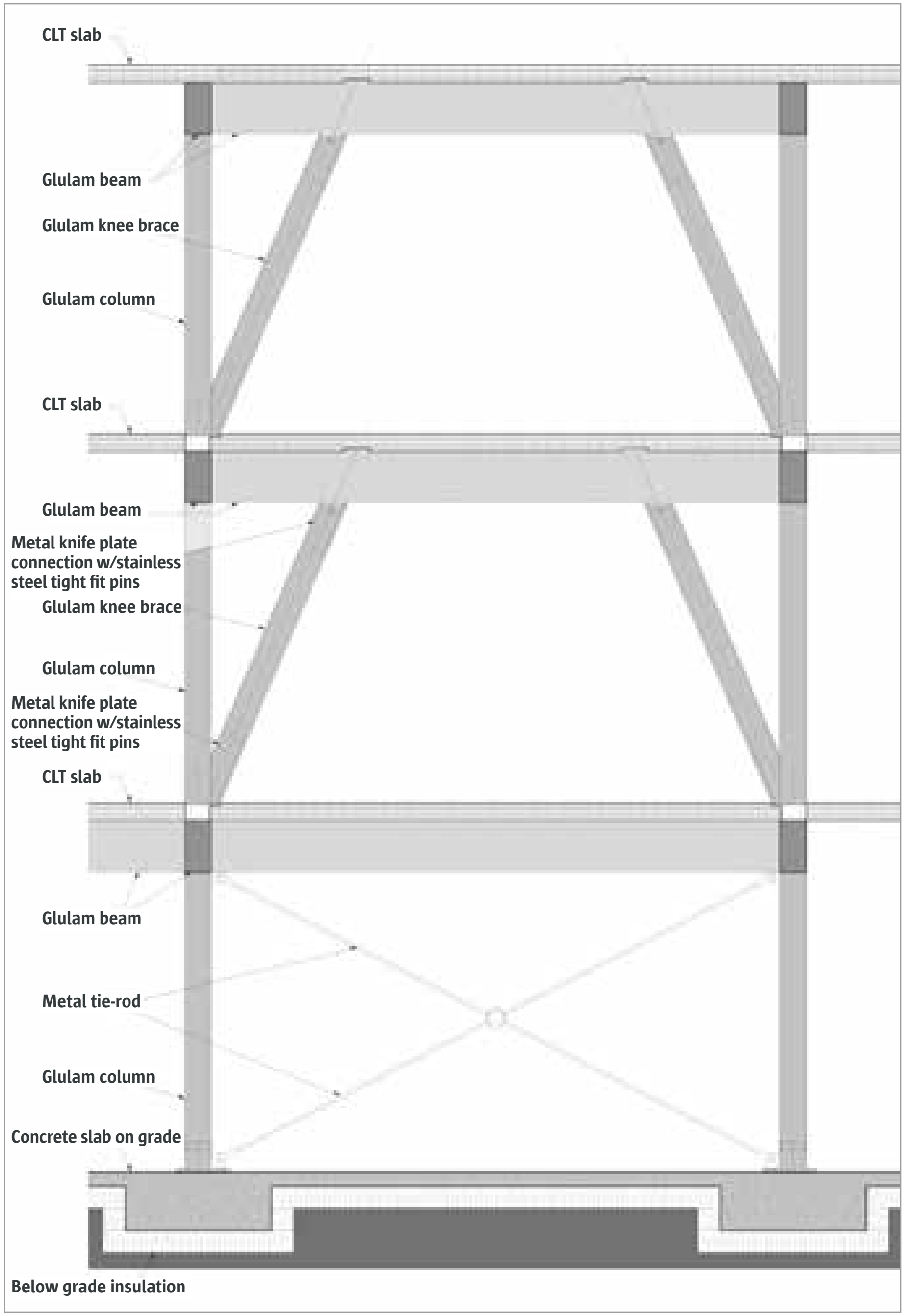


4.12: PH1: Section through exterior wall, abutting adjacent building

4.2 Structure

The structure consists of a slab on grade with a 100-millimetre upstand around the perimeter on which the wood structure sits. The primary structure is a hybrid post-and-beam frame. Glulam beams span across the 6.56-metre (21 feet and 6 inches) width of the building. The beams are supported on glulam columns on the south side and a combination of glulam and steel (HSS) columns on the north side. End connections are made using steel hangers and knife plates. The floors and roof consist of 5-ply, 175-millimetre (7 inches)- thick CLT panels spanning 6.10 metres (20 feet) between beams across most structural bays, with shorter spans at the east and west ends of the building.

Panel-to-beam connections consist of pairs of long stainless-steel screws set at opposing 45-degree angles, while joints between the CLT panels use continuous plywood splines set into rebates at the panel edges and screwed in place. This is a similar detail to that used for the vertical joints between CLT panels in the north wall and creates a floor diaphragm that contributes to the lateral load-resisting system for the building.



4.13 and 4.14: PH1: The lateral system includes glulam 'knee braces' that connect to the glulam beams at an angle to create the required rigidity. Concealed steel plate connections, fastened with pins, provide the required ductility.

Lateral forces are transferred to the ground by two circulation cores located in the northeast and northwest corners of the building and constructed using continuous vertical CLT panels. The hold down system for the CLT panels consists of HSK anchors, one end of which is embedded in the concrete slab, the other epoxy-glued into the CLT.

In the east-west direction, additional lateral resistance is provided by bracing located between the columns on the south side of the building. On the ground floor where there are large windows, this takes the form of slender cross bracing, with steel tension rods connected at floor and ceiling level to the glulam structure by steel plates. On the upper floors, the bracing takes the form of diagonal glulam struts that extend from the base of the glulam posts, at an angle of 30 degrees from vertical, to the underside of the beam above (Figures 4.13 and 4.14). The location of these braces is carefully coordinated with the window pattern on the south elevation.

4.15: PH1: The prefabricated wood structure was erected in just ten days

4.16 and 4.17: PH1: Prefabricated mass timber construction reduces site deliveries and disruption to traffic. Because assembly requires only hand tools, the level of noise and disturbance to occupants of neighbouring buildings is also reduced.

4.3 In Conclusion

The integrated design and construction process and the factory prefabrication of all mass timber components reduced the on-site construction time to just ten days for the entire superstructure (Figure 4.15). This, in turn, greatly reduced the disruption to traffic in a very busy area of the city. An additional benefit to residents of the adjacent apartments was the fact that construction of the wood elements required only hand tools, which are much quieter than the various machines required for other types of construction (Figures 4.16 and 4.17).

> "People are asking for these buildings because they are visually warmer, healthier and more environmentally friendly."
>
> **John Hemsworth**
> *Hemsworth Architecture*

5.0 PROJECT CREDITS

5.1 MEC Flagship Store

Tenant/Developer: Mountain Equipment Co-op
Owner: Beedie Group
General Contractor: Heatherbrae Builders
Project Manager: Green Building Consulting
Architect: Proscenium Architecture + Interiors
Retail Design: Aedifica Architecture + Design
Landscape Architect: Enns Gauthier Landscape Architects
Structural Consultant: Fast + Epp
Mechanical/ Electrical Consultant: Pageau Morel
Engineered Wood Fabricator: Structurlam Mass Timber Corporation

5.2 Fast + Epp Home Office

Owner: Yukon Street Holdings Ltd.
Architect: f2a architecture
Project Manager: Companion Construction
Interior Design: HCMA Architecture + Design
Landscape Architecture: eta landscape architecture
Structural Engineer: Fast + Epp
Mechanical Engineer: HIH Energy
Electrical Engineer: Opal Engineering
Code Consultant: GHL Consultants
Building Envelope Consultant: Aquacoast Engineering
Geotechnical Engineer: Geopacific Consultants

5.3 PH1

Owners: Babco Equities Ltd.
Architect: Hemsworth Architecture
Structural Engineer: Equilibrium Consulting Inc. (A Katerra Company)
Contractor: Naikoon Contracting Ltd.
CLT and Glulam Supplier: Structurlam Mass Timber Corporation
Prefabricated Insulated Panels: BC Passive House
Prefabricated CLT Structural Insulated Panels: Naikoon Contracting Ltd.
Mechanical Engineer: MCW Consultants Ltd.
Civil Engineer: Vector Engineering
Geotechnical Engineer: GVH Consulting Ltd.
Code Consultant: LMDG
Passive House: Peel Passive House Consulting Ltd.
Electrical: MCW Consultants Ltd.
Landscape: Prospect & Refuge
Street Lighting: DMD & Associates Ltd.

MEC Flagship Store

Fast + Epp Home Office

PH1

NATIONAL FUNDER

Natural Resources Canada / Ressources naturelles Canada

NATIONAL PARTNERS

CertainTeed Saint-Gobain • StructureCraft • Structurlam Intelligence In Wood • Western Archrib Structural Wood Systems • Weyerhaeuser • LP Building Solutions • Kalesnikoff Timber Inspires

PROVINCIAL FUNDER

Forestry Innovation Investment

INDUSTRY FUNDERS

COFI BC Council of Forest Industries • ILMA Interior Lumber Manufacturers' Association • CMSA

PROVINCIAL PARTNERS

Boise Cascade Engineered Wood Products • rothoblaas

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Atlantic Program 1-902-667-3889

National Office 1-800-463-5091

US Program 1-858-243-1620