Bayview Elementary School

Wək̓ʷan̓əs tə syaqʷəm Elementary School

Advancing Mass Timber Systems in Vancouver Schools

A CASE STUDY

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1.0 Introduction

This case study examines the design and construction of two elementary schools in Vancouver, British Columbia in which mass timber was chosen as the primary construction system for the first time. Wək̓ʷan̓əs tə syaqʷəm Elementary School (formerly Sir Matthew Begbie Elementary School) and Bayview Elementary School, located on the east and west sides of the city respectfully, were part of a pilot project by the Vancouver School Board (VSB) aimed to assess the potential for expanding the use of mass timber in future school projects (Figures 1.1 and 1.2). To this end, the documentation of: the opportunities presented, the challenges faced and the lessons learned, is a vital step in the evaluation process.

2.1 Clayton Community Centre

2.2 Wesbrook Community Centre gymnasium

2.0 Background

In the past two decades, several countries located on the seismically active Ring of Fire region that encircles the Pacific Ocean have experienced severe earthquakes and suffered extensive damage to their built infrastructure. In 2004, aware of the risk that British Columbians were facing, the Province of British Columbia's Ministry of Education commissioned the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC)[1] to evaluate the condition of its schools. The ensuing report recommended the upgrading or replacement of 339 schools identified as being at risk of severe damage in the event of a major earthquake.

The VSB completed 13 replacement schools from 2012 to 2022, using wood frame, steel, cast-in-place concrete, concrete block and hybrid construction. Most of the buildings are two-storey, to accommodate growing enrolment on small sites. The design life of the average school is 60 years with elementary schools on the shorter side due to the fact that they are subject to significant wear and tear.

Over the same decade, the range of construction options available to meet the most stringent seismic requirements has expanded. Since the introduction of cross-laminated timber (CLT) to Canada in 2012, our growing understanding and experience with the material has confirmed its viability for an expanded range of applications, including low-rise commercial, recreational and institutional buildings. The consultants for both the school projects featured in this case study have previous experience with mass timber construction. Examples of their work are featured in Figures 2.1 and 2.2.

1 Now the Engineers and Geoscientists of BC (EGBC)

3.1 Bayview interior

3.0 Designing Schools

Tight budgets and prescriptive programs have long characterized the design requirements of public schools in British Columbia. These quantitative documents specify the numbers, types and sizes of spaces provided in an elementary or secondary school, based on the number of students enrolled. Over and above the total area of the functional spaces, a 5% allowance is made for internal circulation. With these constraints, creativity and commitment to good design are essential if the building is to meet the qualitative aspirations we now have in place for our public buildings (Figures 3.1 and 3.2).

The 21st century ushered in an era of rapid technological and social change, an explosion in our collective knowledge base, a fundamental shift in how we access that knowledge and how we interact with one another. This has led to changes in educational philosophy that in turn, have implications for the design of schools. Beyond the longstanding foundational competencies of literacy and numeracy, the BC educational system now also focuses on critical thinking, communication, personal and social skills. These goals are best served by flexible spaces of various sizes and types that facilitate individual and collaborative teaching and learning opportunities, both formal and informal. As this case study demonstrates, mass timber lends itself seamlessly to the creation of flexible spaces, using a combination of loadbearing posts and panels with long spans made possible using composite glulam and CLT elements.

3.2 Interior view of Wək̓ʷan̓əs tə syaqʷəm atrium

4.1 CLT installation at Bayview

4.0 Making the Case for Mass Timber

The BC Ministry of Education announced funding for two replacement schools in 2017, a time when the cost of traditional construction materials was escalating rapidly; concrete because of the high volume of condominium construction; steel because of tariffs imposed by the US government. The VSB therefore needed a building system that was cost effective and offered many other benefits, such as faster construction.

With extensive experience in the design and construction of post and beam homes throughout BC, Steve Snyder, Project Manager with the VSB, identified that in this rising materials market, mass timber construction could offer a viable and cost-effective alternative for these projects. While the material offered several important advantages including increased speed of construction and a low carbon footprint, Snyder knew the decision would ultimately rest on a sound business case.

The business case for the two schools was developed in tandem; with the structural engineer (Fast + Epp) keeping material options open. An estimator familiar with mass timber construction was retained for each project, primarily to ensure that design solutions would optimize the use of mass timber and that no ‘uncertainty premium’ was added in to the estimates. For Snyder, this was an important strategy, as he noted, “The uncertainty around CLT comes from its comparative newness, with quantity surveyors divided on potential cost, quality and reliability of supply.”

The strategy worked, as the final estimates were within 1% of the VSB budget. This contrasted with the last concrete school project, which came in at more than 10% above the established budget.

The potential cost advantages of mass timber construction identified in the business case were:

- Accelerated schedule for site construction as mass timber components can be factory prefabricated while foundation work is proceeding on site.
- The ‘kit of parts’ approach to mass timber, together with its precise manufacturing tolerances makes for quick erection and enclosure of the building, as well as reducing expensive crane time (Figures 4.1).
- The relatively light weight of wood (compared to concrete or steel) can also reduce the size of foundations and the time required to form and pour them.
- The use of 3D modelling to coordinate the work of different design disciplines and subtrades can identify and resolve ‘clashes’ that might otherwise result in delays on site.
- The inherent thermal resistance of mass timber panels can reduce the requirement for additional insulation in exterior walls, decrease overall wall thicknesses and reduce cost.
- The durable, self-finished quality of mass timber elements can reduce the need for interior finishes such as drywall.

Other benefits included:

- Prefabrication reduces the number of truck deliveries required for a given project, and the assembly process requires only hand-held power tools; both greatly reducing the noise and inconvenience to the surrounding neighbourhood.
- The low embodied carbon inherent in mass timber construction represents a proactive step towards compliance with the carbon neutrality requirements of the provincial Climate Change Accountability Act (which covers all public sector organizations, including the VSB).
- Scientific evidence supports the fact that exposed wood within buildings reduces the production of stress-related hormones in the sympathetic nervous system (SNS), lowering anxiety levels for building occupants.

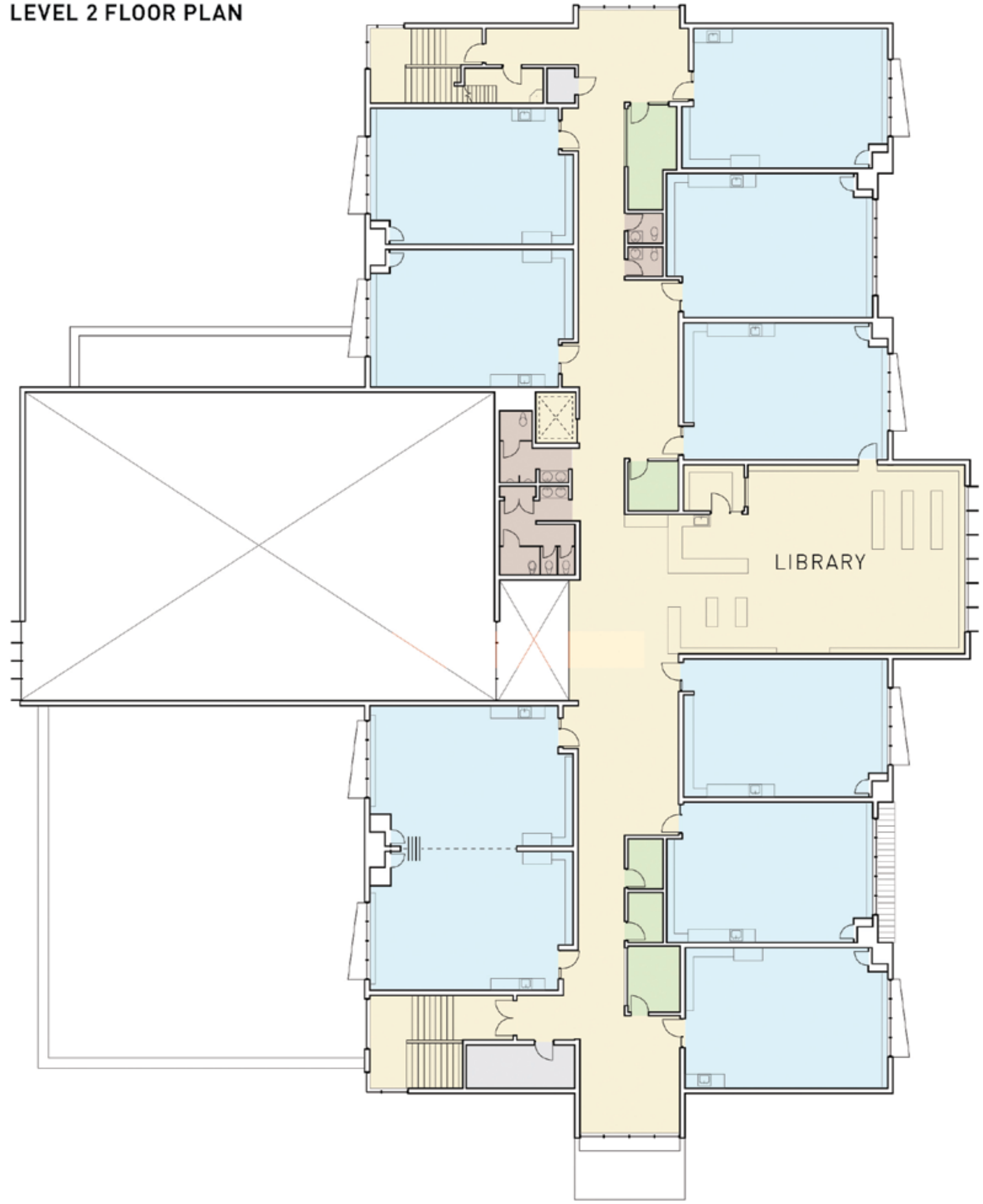
From an owner’s perspective, the challenges Snyder faced were:

- The long delivery times for CLT, which required that materials be ordered and commitments obtained well in advance of delivery dates.
- The traditional open competitive bid procurement process does not guarantee an experienced contractor, so the client must rely heavily on the experience and expert advice of the architect and structural engineer.
- Quantity surveyors were retained for both schools, but because they were familiar with traditional processes, they needed to gain a better understanding of the construction mobilization, sequencing, and coordination of mass timber buildings in order to accurately cost the project.

With these opportunities and challenges carefully addressed, the business case for mass timber was reviewed and approved by VSB during the design development phase, enabling the structural design of both projects to be optimized for mass timber from that point forward.

LEVEL 1 FLOOR PLAN

LEVEL 2 FLOOR PLAN



- Classroom
- Learning commons/ circulation
- Breakout rooms
- Restrooms
- Storage and Services
- Offices
- Large gathering space

5.2 Bayview floor plans

5.3 Bayview building section

5.0 Bayview Elementary School

Bayview Elementary School occupies a tight 0.9-hectare site in Vancouver's Kitsilano neighbourhood. The existing school included an aging 2.5-storey masonry structure (Figure 5.1) that was built in two phases; the first in 1914 and the second in 1929 with additions and improvements dating from the 1950s and 1960s. Seismic upgrades were not a viable option so all these structures needed to be demolished. Due to poor soil conditions elsewhere on the site, the new mass timber structure had to be contained within the previous building footprint.

5.1 Original Bayview building

5.1 Architecture

Designed by Francl Architecture with Fast + Epp as the structural engineers, the new 3510 square metre, two-storey building accommodates 365 students from pre-school to Grade 7. The building is designed with flexible, open and interconnected spaces that provide opportunities for all types of learning from personalized, individual learning to collaborative and classroom-based learning (Figures 5.2 and 5.3).

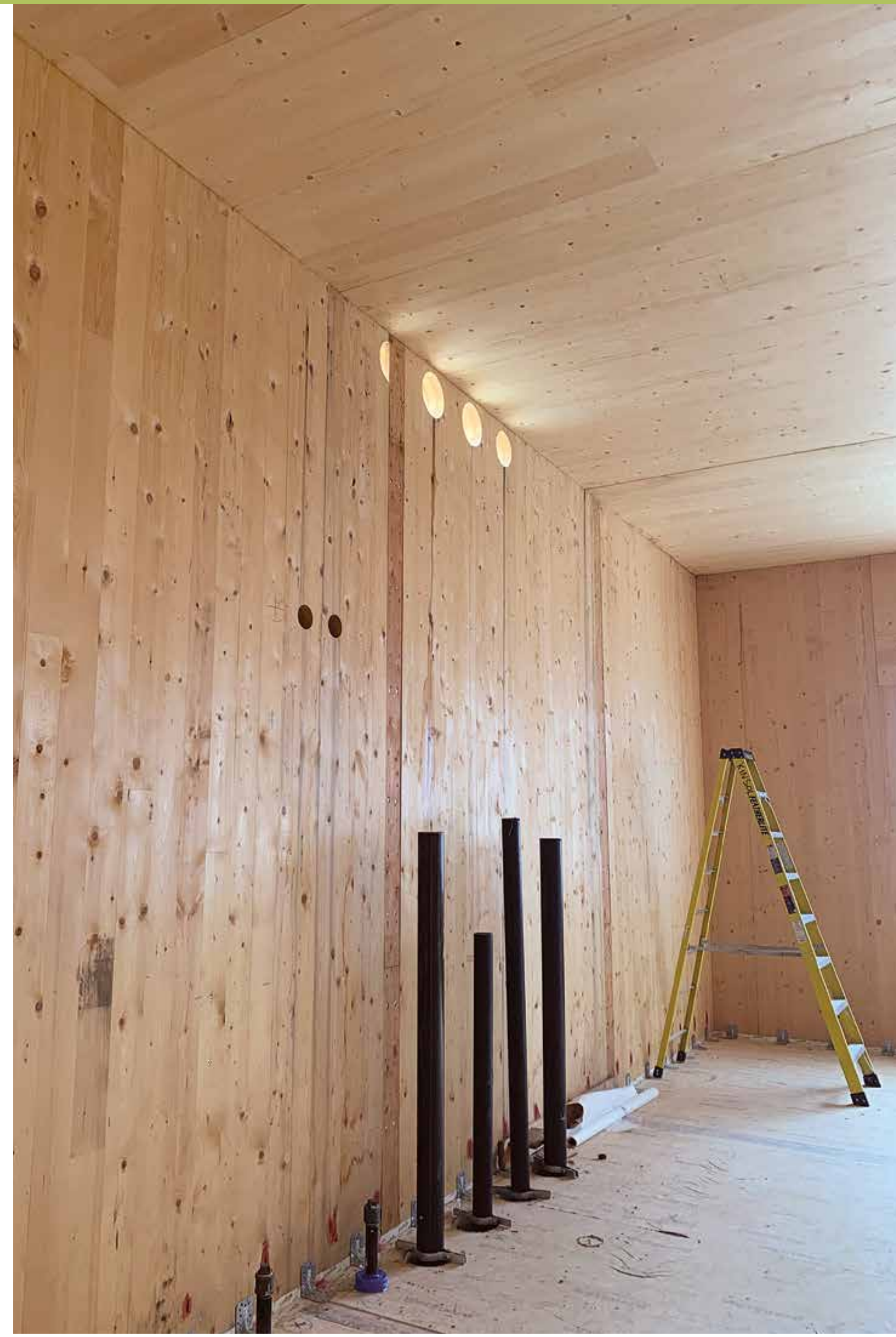
Organized along a central circulation spine, the lower level includes administrative areas, classrooms, two multipurpose rooms and a large gymnasium (Figure 5.4). The upper floor includes the remaining classrooms, and an open concept library (Figure 5.5). The classroom volumes are staggered in plan, with corridors widened to create breakout areas, seating, and hang-out spaces. Some classrooms have operable walls, enabling the joining of two classes for larger group activities.

5.4 Bayview gymnasium

5.5 Rendering of Bayview library

5.6 View of trees from stairwell

5.7 Exterior cladding of Bayview



5.8 Exposed services prior to enclosure in service wall

5.9 Main circulation spine

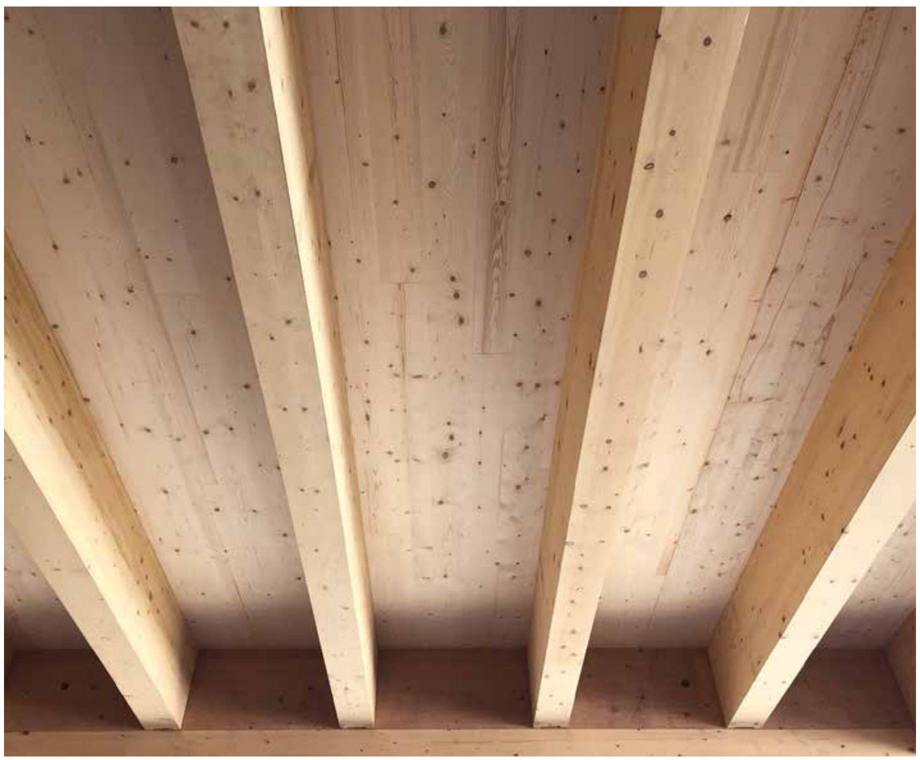
On the upper floor, the library opens to the corridor creating a larger, more flexible space and opportunities for informal learning. The main space includes large windows with views into a surrounding mature tree canopy. The stairwells also have corner windows oriented toward the trees (Figure 5.6) whose fall colours carry inside to the palette of interior surface finishes. The exterior colour scheme is a neutral combination of white brick masonry and charcoal grey metal cladding panels (Figure 5.7) while building massing and solar shading devices prevent heat gain and glare.

The architects wanted to leave as much wood as possible exposed, while managing systems integration as neatly as possible. To this end, they made strategic choices throughout the school. The gymnasium and multipurpose room have fully exposed CLT on the wall and roof surfaces, as do the stairwells. The outside walls of classrooms and portions of the library also feature exposed CLT. By contrast, the administrative areas are framed with steel studs and finished in drywall, to facilitate the distribution of electrical and telecommunications services and to permit the easy mounting of receptacles and outlets. A similar approach appears in the classrooms, with each having at least one framed service wall (Figure 5.8). Wall surfaces along the circulation spine in most corridor areas are also finished in drywall to provide a suitable surface for pinning bulletins and posters (Figure 5.9).

The original plan was for the exterior wall structure to include sections of both CLT and steel stud, according to the exterior finish used. However, this was changed to an all CLT solution, simplifying installation and eliminating the challenge of coordinating multiple trades working at close quarters. This decision also simplified the approach to insulation and, because of the inherent thermal resistance of CLT, reduced the thickness of additional insulation required.

5.10 CLT spendrel panels

5.11 Library cantilever



5.12 Double Tee panel

5.2 Structure

The requirement to stay within the footprint of the original building limited the size and, to some degree, the articulation of the building. The foundations consist primarily of conventional spread footings with grade beams under shear walls. In some locations where overturning forces were greatest, micro piles were required.

The structure is a mass timber hybrid with a combination of CLT walls and glulam posts carrying the vertical loads. The exterior CLT walls and some of the CLT demising walls between classrooms also resist lateral loads. Around the perimeter of the building, the relatively short stretches of the CLT walls are tied across the window openings using horizontal header and spandrel panels (Figure 5.10) with steel plate shear connectors stiffening the overall system and distributing the seismic forces. A smaller number of CLT walls resist lateral forces in the other direction. The walls are tied together horizontally with CLT floor and roof diaphragms, and the entire system is anchored to the gymnasium, which is designed as a rigid box that resists a large portion of the lateral loading imposed in that direction.

As with all new school buildings, Bayview is considered a high importance structure in terms of its seismic resistance. Such buildings are designed to remain structurally sound (if not fully operational) and able to provide shelter for the surrounding community in the aftermath of a major seismic event. This is the second most rigorous seismic standard, after a 'post disaster' designation. The comparatively lightweight mass timber structure helps reduce the overall magnitude of seismic loads, and the ductility inherent in mass timber shear wall systems is well suited to the performance requirements of this category of buildings.

5.13 Double Tee installation

5.14 Section through gymnasium and circulation

5.15 Glulam ledger detail at concrete upstand

For the majority of the building, 7-ply CLT floor panels span between demising walls. In some locations, double cantilevers were achieved by using larger (3-metre wide) panels to capitalize on the 2-way spanning capability of CLT (Figure 5.11). For the slightly longer span across the library, 9-ply panels were used. Where the library cantilevers out beyond the ground floor, the exterior CLT wall panels incorporate an embedded steel plate at the top and bottom, enabling the wall to act as a beam.

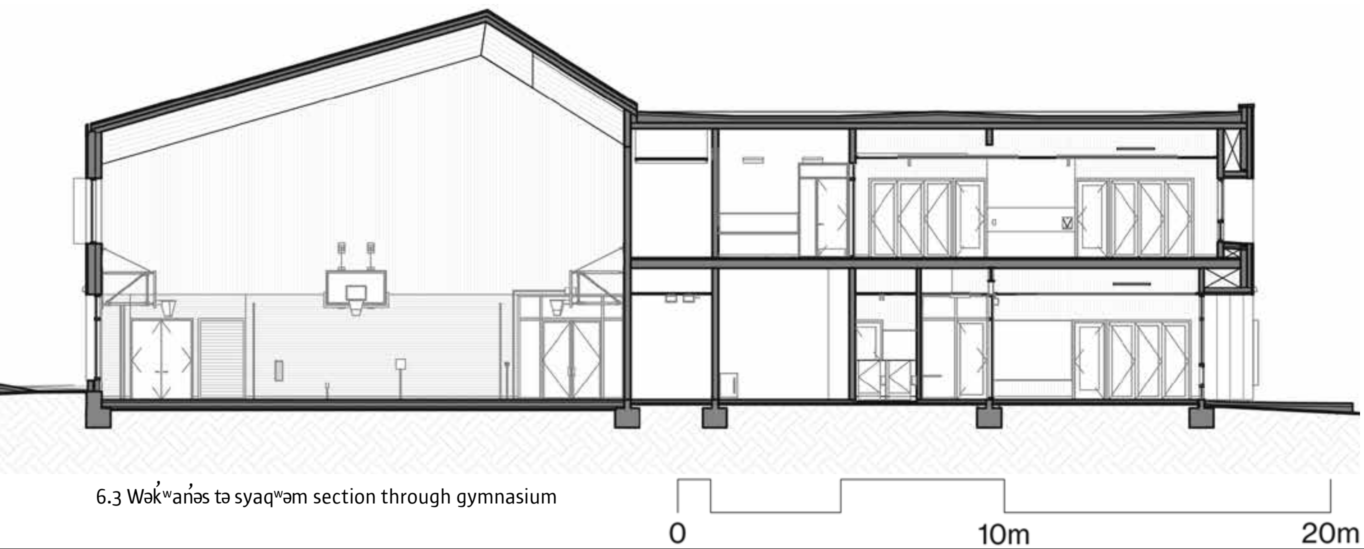
The roof over the gymnasium and multipurpose room has a span of 16 metres. The structure consists of composite glulam and CLT Double Tee panels (Figure 5.12). This solution addressed both the gravity and lateral load requirements within a 785-millimetre structural depth, providing the required interior clearance for sports activities and maintaining continuity of the lateral system by tying the gymnasium roof in to the roof of the adjacent classroom block. This system demonstrates the efficiency of composite glulam and CLT construction, being approximately 300 millimetres shallower than traditional open web steel joist and corrugated metal deck systems. Similarly, over short and medium spans, a 175-millimetre (7-ply) CLT panel system is equivalent to a 500-millimetre deep steel joist and corrugated metal deck structure.

Alternative connection systems for the Double Tee panels were tested at the University of Northern British Columbia, with the chosen solution also being the simplest – mechanical fastening of the CLT to the glulam beams using long, fully threaded inclined screws. The panels were field assembled on the ground before being lifted into place by crane (Figure 5.13). The roof diaphragm steps at the corridor, to allow for a continuous clerestory that admits daylight to the heart of the building (Figure 5.14). Moment connections at the top and bottom of the clearstory transfer the lateral forces across this discontinuity in the horizontal diaphragm.

Elsewhere, the beam-to-column and beam-to-wall connections are concealed hangers. Hold-downs for the CLT shear walls are vertical steel straps surface-mounted on the side of the wall to be furred out to conceal service runs. The bottom of the L-shaped strap is fitted over a threaded steel rod cast into the continuous concrete upstand beam. Between the hold-down points, glulam ledgers are used to ensure a consistent horizontal surface designed to facilitate quick installation of the wall panels (Figure 5.15).

The mass timber installer worked with the general contractor to create a comprehensive moisture management plan that included: the factory installation of temporary membranes on all CLT panels, the sealing of end grain surfaces on all mass timber elements, a precise delivery schedule and the provision of protected onsite storage. Together, these measures minimized the risk of water damage.

6.2 Aerial view rendering of building, site and context



6.3 Wək̓ʷan̓əs tə syaqʷəm section through gymnasium

6.1 Sir Matthew Begbie Elementary School

6.0 Wək̓ʷan̓əs tə syaqʷəm Elementary School (formerly Sir Matthew Begbie Elementary)

The school is located in a predominantly single-family residential neighbourhood in east Vancouver. The existing building dates from 1922 and remains in temporary use, operating as a ‘swing site’ for other upgrade and replacement school projects in the vicinity.

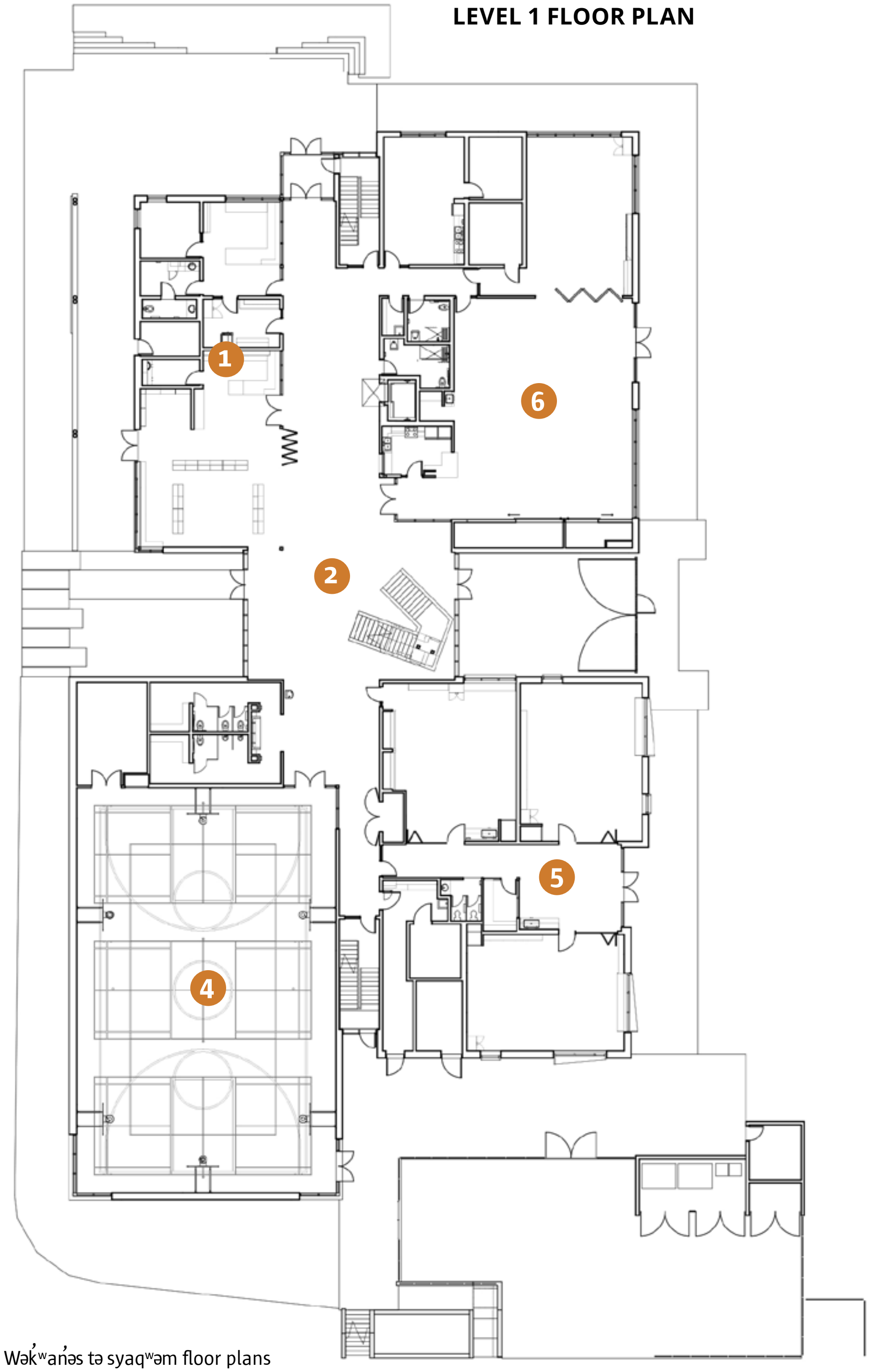
Wək̓ʷan̓əs tə syaqʷəm is the name gifted to the new school by the xʷməθkʷəy̓əm (Musqueam) Nation. It is written in the xʷməθkʷəy̓əm traditional hən̓q̓əmin̓əm̓ language meaning, “sun rising over the horizon.” This name is both a recognition of the longstanding Hastings-Sunrise Vancouver neighbourhood and speaks to the new beginnings for this school community (Figure 6.1).

6.1 Architecture

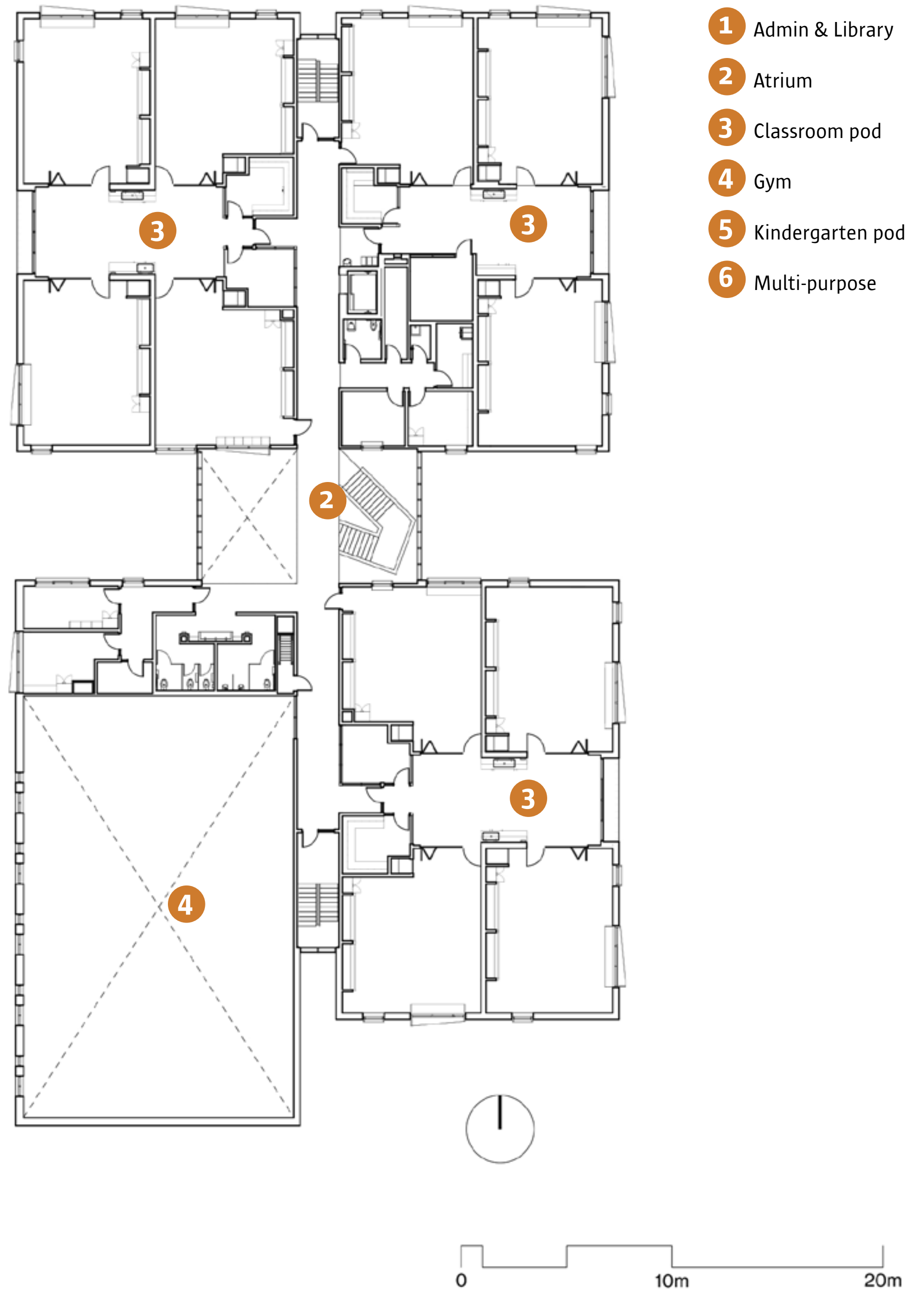
The large site steps down in three stages from west to east, with the existing school facing Lillooet Street at the highest level; the new school located on the middle level (Figure 6.2) and a playfield occupying the lowest level.

Designed by **hcma**, with Fast + Epp structural engineers, the 3,400 square metre design of the new school is spread over two storeys (Figure 6.3 and 6.4) and accommodates 340 students from Kindergarten to Grade 7. The structure uses loadbearing CLT floor, wall and roof panels, with glulam beam elements.

LEVEL 1 FLOOR PLAN



LEVEL 2 FLOOR PLAN



1 Admin & Library
2 Atrium
3 Classroom pod
4 Gym
5 Kindergarten pod
6 Multi-purpose

6.4 Wək̓ʷan̓əs tə syaqʷəm floor plans

6.5 Exterior rendering showing articulation of building

The plan was specifically developed to address the site conditions and context. Intersecting circulation routes divide the two-storey building into four quadrants. A double height gymnasium occupies one quadrant while the others accommodate the administration space, library, multi-purpose room, a preschool and kindergarten pod and three other pods of four classrooms each. The classrooms have full height glazed partitions with double doors opening onto a shared common space.

The floor plan was intended to create a 'classroom commons' effect in which smaller groupings are created within a larger space. This is a departure from conventional classroom design and increases circulation, eliminates narrow hallways, and provides more common multi-functional spaces. This layout also breaks up the massing of the building, to better fit the scale of the neighbourhood (Figure 6.5).

A glazed, double-height atrium runs through the center of the new building, forming the heart of the school and linking the east-facing entrance and playing field with the west-facing outdoor classroom and fern garden (Figure 6.6). The result is a design that is both bisected and conjoined; with common spaces encouraging social interaction among students and teachers. Way-finding throughout the building is straightforward, with clearly defined north/south and east/west circulation axes terminating in glazed doors.

The CLT design assist/estimator retained for this project had European experience, so the design assumptions, including standard panel dimensions and thicknesses and material specifications and fabrication capabilities were based on European materials and practices. The design, bid, build contractual arrangements required for public tenders, ultimately resulted in the appointment of a local CLT fabricator, so a number of minor changes had to be affected during the shop drawing phase.

From the outset, the objective had been to expose as much of the CLT as possible in all the interior spaces, including classrooms, hallways, the library, multi-purpose room and gymnasium (Figure 6.7). To facilitate this, building systems were grouped together and routed horizontally through a service drop in the east/west hallway; sections were furred out in each classroom; and elsewhere chases cut into CLT panels.

Although not ideal, shop drawings for the CLT panels were done prior to the appointment of mechanical and electrical subtrades, leading to a considerable amount of work being required in the field (Figure 6.8). For example, a finishing carpenter created cover strips to conceal conduits and wiring running through chases routed in the CLT. Cutting of precise rectangular recesses in the CLT to house junction boxes and electrical receptacles was problematic. While European manufacturers can generally cut these rectangular recesses accurately in the factory, local suppliers typically cannot (Figure 6.9). This was one of several minor variations in the services offered by different suppliers, reinforcing the need for clear and complete specifications and early coordination with the chosen CLT fabricator.

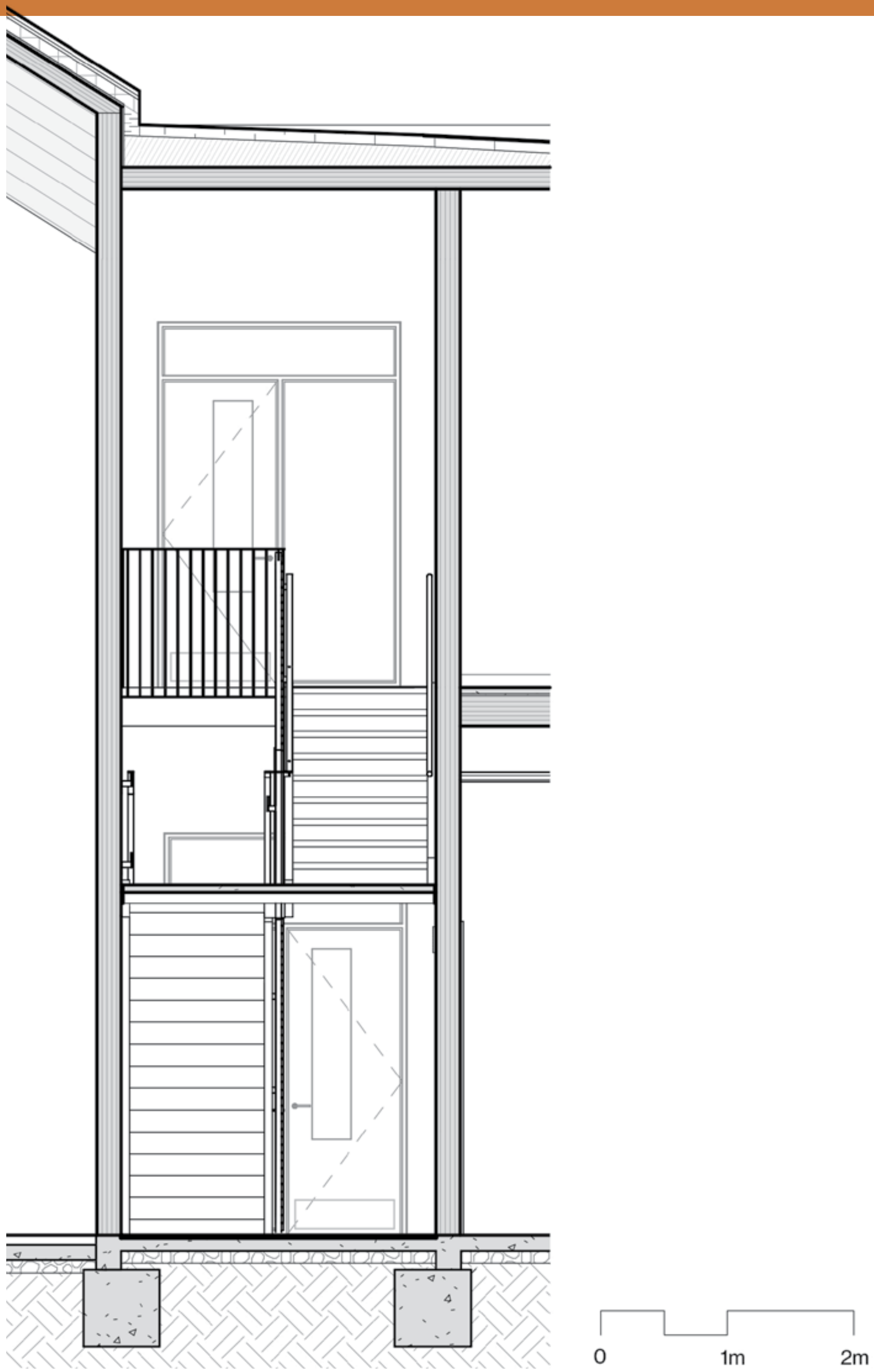
6.6 View of atrium

6.7 The interior features exposed CLT throughout

6.8 A chase routed into the CLT to conceal conduit

6.9 A circular hole for a square receptacle requires a custom cover plate

6.10 The double cantilever is supported by projecting CLT walls reinforced with steel



6.11 Section through wall of stairwell

6.2 Structure

The overall program area is almost identical to that of Bayview, but the layout and articulated massing makes it feel larger. The majority of the gravity loads are carried on loadbearing CLT panels (with the exceptions noted below). However, the upper level cantilever covering the walkway that runs around the building made the resolution of gravity and lateral loads more challenging than at Bayview.

The basic approach to the cantilevers was similar, using the projecting demising walls as wall beams. In this case however, the extent of the cantilevered sections accentuated the discontinuity in the lateral system. With the exterior walls of the upper and lower storeys being offset in plan along their entire length, loads could not be easily carried through to the ground.

In order to ensure that these walls did not attract loads they were unable to resist, slip joints (i.e. slotted connections) within the steel top and bottom plates were used to redirect the lateral forces in this area to the shear walls strategically located elsewhere in the building (Figure 6.10). This system requires strong connections between the elements carrying the horizontal forces and those carrying the vertical forces to the ground.

The continuous, two-storey high CLT stair shafts and the perimeter walls of the gymnasium are important elements in the lateral system, carrying the forces from the roof, shear walls and floors to the ground. Currently, the Wood Design Code does not specify construction that includes continuous, multistorey shear walls in CLT.

In order for this solution to be approved, testing was conducted on the connection between the vertical CLT panel and the suspended intermediate floors. With the codified storey height or platform frame approach, the floors are built into, and supported on, the vertical wall elements. In a seismic event, walls and floors are able to move in unison, maintaining both the gravity and shear capacity of the assembly. Testing confirmed that the performance of the balloon frame option met the requirements of the code (Figure 6.11).

The gymnasium has a dramatic, asymmetric double-pitched roof, supported on five pairs of glulam girders (Figure 6.12). The short and long elements of the roof are joined by heavy moment connections at the ridge. The span between girders is bridged by 5-ply CLT panels, screwed into place. The multipurpose room features custom fabricated Double Tee panels similar to those used at Bayview since these are shallow enough to achieve the required span within the same floor-to-ceiling height as the adjacent classrooms.

To facilitate quick and easy installation, the CLT wall panels were installed using a similar sectional glulam kerb ledger detail as was used at Bayview. However, because


6.12 Interior view of gymnasium

6.13 Hold down detail of hollow structural section box

6.14 Hold down detail of glulam ledger

the architects wanted to expose both sides of the CLT shear walls, a concealed hold-down detail was required. In this case, the hold downs are steel brackets that fit over the cast-in steel rods. The connection is made within a hollow structural section (HSS) box (Figure 6.13); oversize holes and washers being used to deal with any tolerance issues between the cast-in-lace concrete and the prefabricated CLT panels. The steel boxes are set between the short glulam ledgers, which were shimmed and leveled prior to installation of the CLT panels (Figure 6.14).

As noted for Bayview, the glulam kerb sections were installed to provide a level, horizontal surface for landing the CLT panels. Addressing tolerance issues beforehand speeds installation and reduces expensive crane time. The alternative, to shim between the CLT and the concrete while the panel is suspended from the crane, would have taken much more time and increased installation costs considerably.

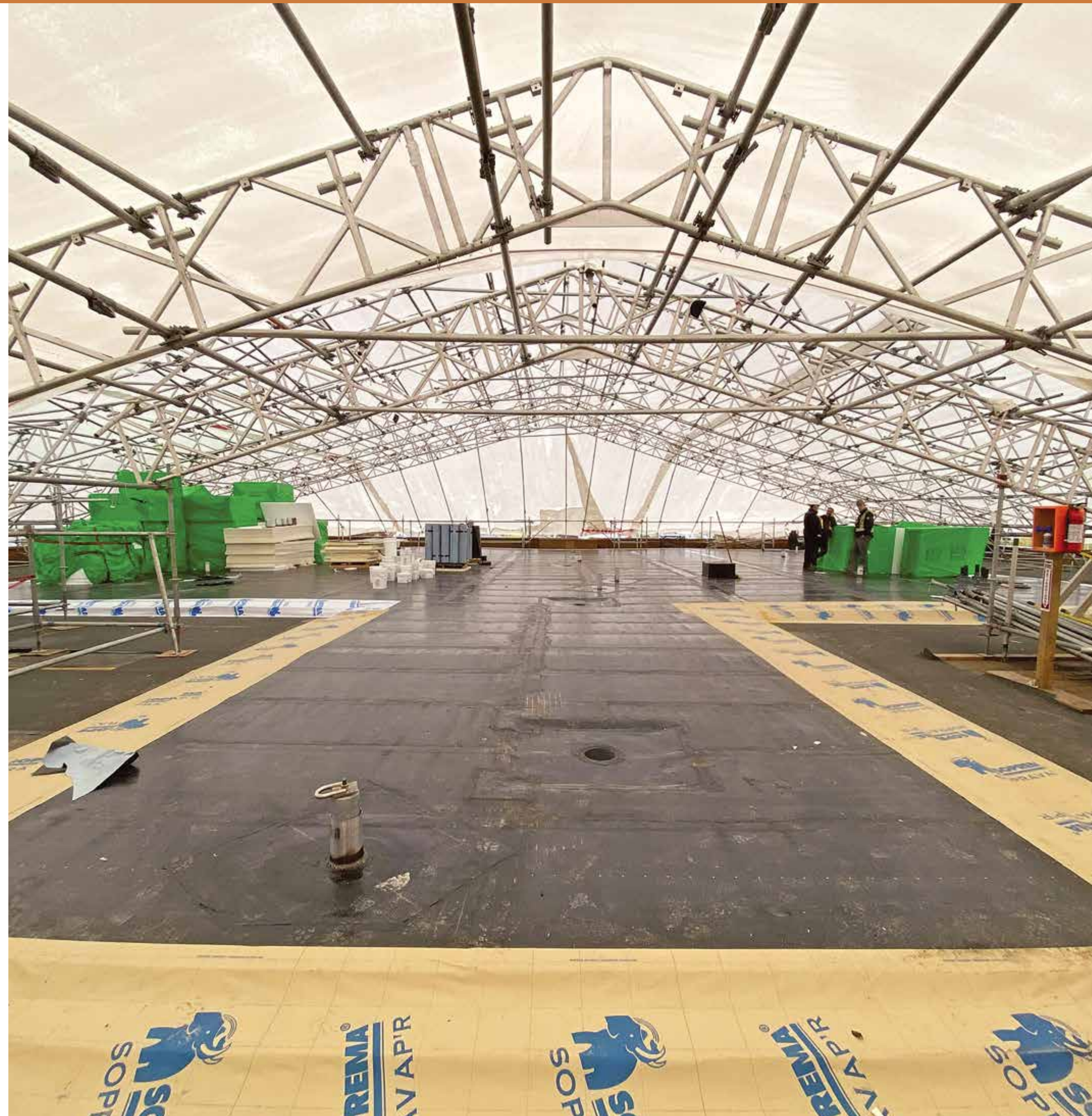
On this project, the installation and leveling of the glulam kerbs took much longer than anticipated; meaning that most of the CLT wall panels had been delivered before the glulam kerb was ready to receive them. The panels, which had been factory wrapped in polythene, were stacked on site without additional weather protection. While the kerb installation was still in progress, an early winter storm struck Vancouver, with high winds tearing open the polythene wrapping and heavy rain soaking the partially exposed panels.

Although the specifications regarding weather protection were identical to those used at Bayview, none of the panels in this case were supplied with temporary membranes so the elevated moisture content of the wood made it difficult or impossible to adhere temporary membranes in the field. A tent was used to protect the stacked CLT panels (Figure 6.15), but drying to the required moisture content of 19% took several

6.15 Protective tent

weeks. When the roof was finally installed, another rainstorm soaked the exposed panels, saturating the plywood splines used to connect the panel-to-panel joints. To dry out the panels and complete the work, it was necessary to protect the roof with a large tent (Figure 6.16).

Unlike at Bayview, many of the CLT wall panels are exposed on both sides, meaning that the hold-down detail needed to be custom designed and fabricated to conceal the connection. In this case, a recess was routed into the bottom face of the panel, fitting over a steel knife plate bolted to the glulam kerb. The concealed plate was then secured using multiple steel pins.



6.16 CLT protected by tent

7.0 Mass Timber and Sustainability

While the focus of this case study is largely technical, the decision to use mass timber also offered the VSB a more environmentally responsible construction solution. This assertion is based on the widespread adherence to third party sustainable forest management (SFM) practices in BC's commercial forests.

As noted previously, British Columbia's public institutions, including the VSB, are required to comply with the provisions of the provincial Climate Change Accountability Act. The VSB has demonstrated a strong commitment to sustainability, ensuring that it is integrated into the learning environment. Having made significant reductions to its overall carbon footprint by concentrating on operating energy efficiencies, the VSB has recently expanded its focus to include the embodied energy (and hence material choices) of its building program.

At Bayview Elementary, the mass timber structural elements were prefabricated by Kalesnikoff Lumber in the East Kootenay region of southeastern British Columbia. The company is vertically integrated, managing its own forests under sustainable forest management protocols, harvesting and processing a range of feedstock for a variety of end products, all of which improve the efficiency of wood fibre utilization.

At Wək̓ʷan̓əs tə syaqʷəm Elementary School, the mass timber elements were fabricated by Structurlam in Penticton, using wood also harvested from sustainably managed forests in British Columbia. The use of locally-sourced naturally renewable timber fits with the school district's commitment to sustainability and low carbon construction, delivering a net benefit of 1420 tonnes of sequestered CO_2 equivalent. The exposed mass timber is an example of biophilic design which brings the feel of the outdoors inside and connects students with nature. With its abundant natural light, the interior is both calming and inspiring.

8.0 Moving Forward

There were many lessons learned by the client, design teams, contractors and subcontractors on these projects, including:

- The design, bid, build contractual arrangements used for public projects in concrete and steel construction, do not easily lend themselves to mass timber projects, which require a much greater degree of coordination and collaboration, starting in the design development phase. A construction management form of contract would be easier to adapt to mass timber construction.
- Costing for mass timber structures should be done by estimators familiar with the project design, delivery processes and protocols specific to this technology. Quantity surveyors with experience with construction management is an asset.
- The decision to use mass timber construction should be made as early as possible; rather than at the later stages of design development. This is because the different structural systems may not be easily interchangeable given the different strength properties, dimensions and span capabilities of concrete, steel and mass timber.
- Prequalification and early appointment of mass timber fabricators and installers are invaluable, given the subtle but significant differences in material sizes (between Canadian and European suppliers), fabrication technology and range of services they offer.
- Clear and comprehensive specifications for mass timber fabrication, moisture protection, transportation and installation should be developed collaboratively between design consultants, fabricators, general contractors and installers to ensure there are no gaps between the various scopes of work.
- Key to the success of any mass timber project, especially in British Columbia, is a comprehensive moisture management plan. If moisture damage can be avoided, the unparalleled speed of mass timber construction can be realized. If moisture damage occurs, the drying times required may result in a delay of several months.
- Whether part of the project team or a third-party expert, there must be a 'modelling champion' involved to ensure coordination of all consultant models, identification of all significant clashes and optimization of panel sizes. This enables any and all significant conflicts to be resolved before starting on site.
- When the 4th dimension of time is added, the collaborative process of virtual construction can be used to optimize site operations; from construction sequencing to the positioning of a crane. The knowledge and experience of the entire team far exceeds that of any individual and should be harnessed as early as possible in the design process.

9.0 Conclusion

Perhaps the most important take-away from this case study is that working with mass timber requires a complete transformation in the way we have traditionally procured, designed and delivered buildings. The two buildings are a testament to the: vision of the VSB Project office; the creativity of the design consultants; the skill of the fabricators, installers and contractors and the commitment of the entire project team. Successful mass timber construction demands a collaborative team approach that begins much earlier in the design process, and engages not only architects and engineers, but wood fabricators, installers and other key subtrades.

More and more, the design and construction of durable, high-performance, socially and environmentally responsible buildings are increasingly preferred over more traditional alternatives. However, they must be seen and accepted as a collective endeavour and a shared responsibility. If that model represents the lateral connections between members of a project team, then we must also consider the vertical integration of working with wood, or what Kalesnikoff Lumber refers to as a ‘seedlings to solutions’ approach.

10.0 Project Credits

10.1 Bayview Elementary School

Client: School District #39 – Vancouver

Architect: Francl Architecture

Structural Engineer: Fast + Epp

General Contractor: Chandos Construction

Mass Timber Fabricator: Kalesnikoff Lumber

Mass Timber Installer: Kinsol Timber Systems

10.2 Wək̓ʷan̓əs tə syaqʷəm Elementary School

Client: School District #39 – Vancouver

Architect: **hcma**

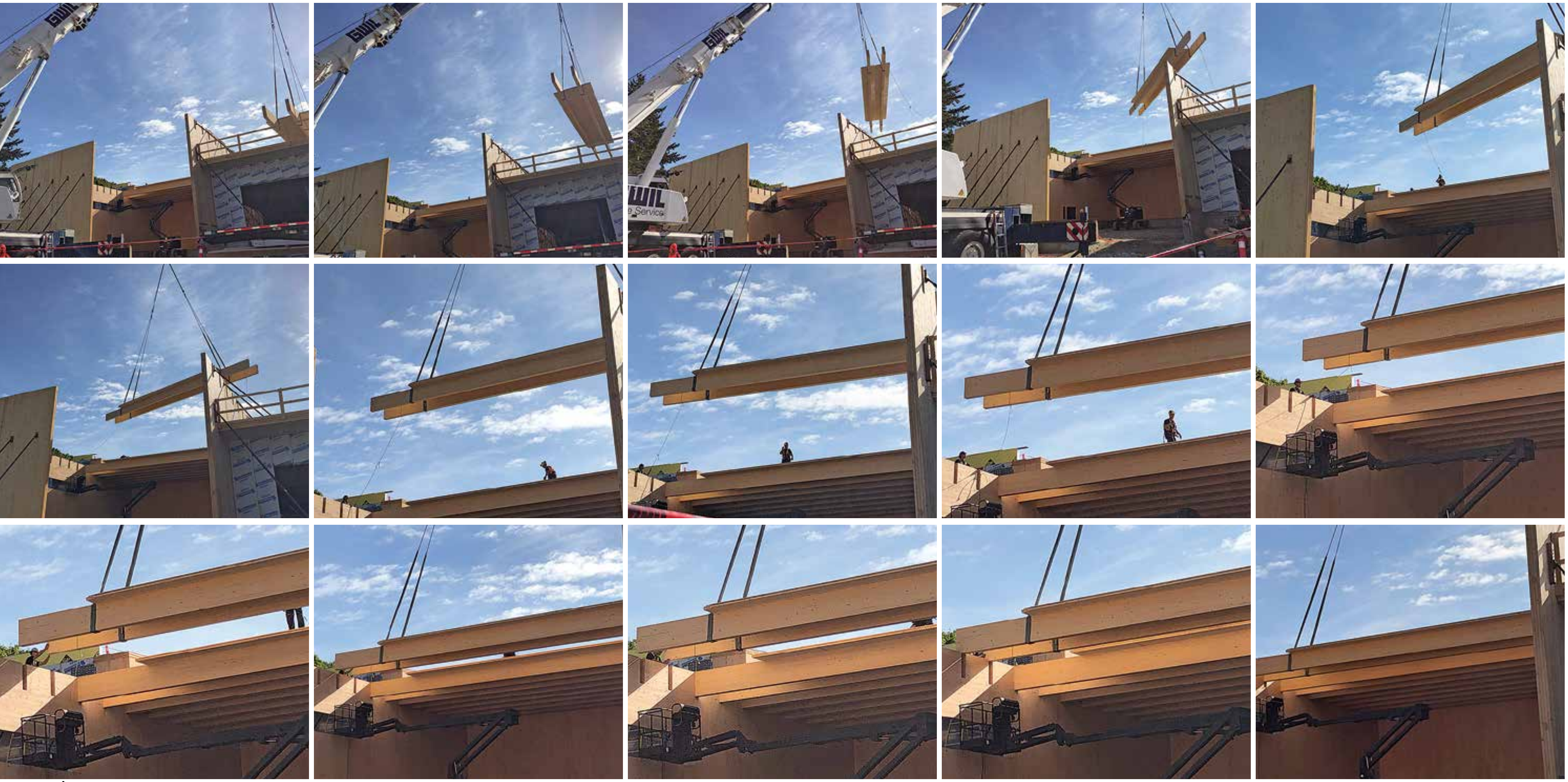
Structural Engineer: Fast + Epp

General Contractor: Yellowridge Construction Ltd.

Mass Timber Fabricator: Structurlam Mass Timber Corporation

Mass Timber Installer: Beam Craft

Bayview construction, assorted photos



Wək̓ʷan̓əs tə syaqʷəm gym panel install

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Natural Resources Canada / Ressources naturelles Canada

NATIONAL PARTNERS

CertainTeed SAINT-GOBAIN

KALESNIKOFF TIMBER INSPIRES

StructureCraft

STRUCTURLAM Intelligence In Wood

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CMSA

PROVINCIAL PARTNERS

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