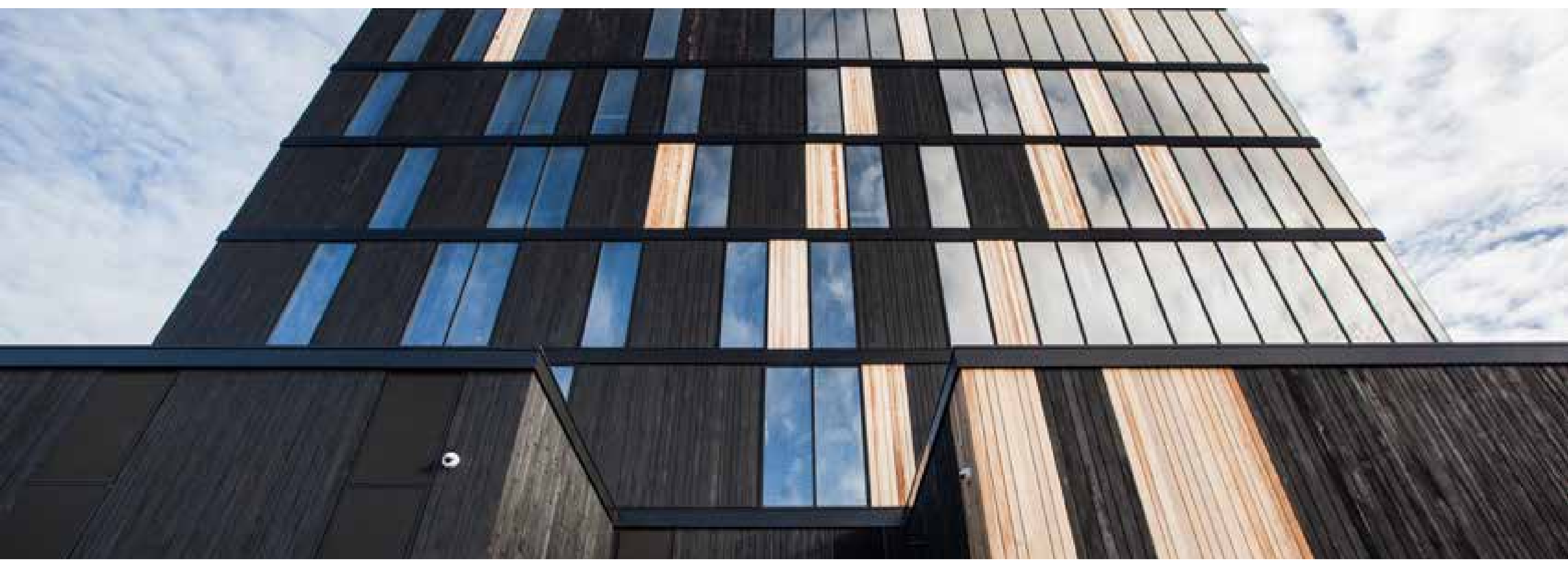


BULLETIN:

WOOD INNOVATION AND DESIGN CENTRE

JUNE 2015

Forestry Innovation Investment

BSLC
Binational Softwood Lumber Council

COVER PAGE PHOTO CREDITS:

Top left: Ema Peter Photography

Top right: Paul Alberts

Bottom right: Ema Peter Photography

Bottom: Brüdder

ADDENDUM TO SURVEY OF INTERNATIONAL TALL WOOD BUILDINGS:

This addendum supplements the publication, *Survey of International Tall Wood Buildings*, published May 2014. The addendum was created after the publication date and does not include information or data from the survey.

For more information on the *Survey of International Tall Wood Buildings* and the addendum, please visit www.rethinkwood.com/tall-wood-survey.

BULLETIN OF LESSONS LEARNED

WOOD INNOVATION AND DESIGN CENTRE, PRINCE GEORGE, BRITISH COLUMBIA

This bulletin presents the lessons learned and experiences gathered from stakeholders who participated in interviews.

OWNER/DEVELOPER
Province of British Columbia — Ministry of Jobs, Tourism and Skills Training; Partnerships BC

DESIGN TEAM
Michael Green Architecture, Equilibrium Consulting Inc., and PCL Constructors Westcoast Inc.

AUTHORITY HAVING JURISDICTION
BC Building and Safety Standards Branch and City of Prince George

CONSTRUCTION TEAM
PCL Constructors Westcoast Inc.

Photo Credit: Ema Peter Photography

The Government of British Columbia's Wood Innovation and Design Centre (WIDC) in the City of Prince George showcases B.C.'s expertise and global reputation as a leader in wood design and advanced wood product applications. The 29.5m tall, six-storey building is now one of the world's tallest modern wood buildings.

The project was delivered under a design-build agreement with the Crown Corporation, Partnerships BC acting as the owner's representative. The building was designed and constructed utilizing a broad range of traditional and advanced techniques.

The project incorporates a number of wood products including Cross Laminated Timber (CLT), glulam beams and columns, Laminated Veneer Lumber (LVL), Parallel Strand Lumber (PSL), Oriented Strand Board (OSB), plywood, and dimension lumber.

Proposed occupancies include academic classrooms, offices and laboratory for the lower floors and commercial uses for the upper floors.

PROJECT VITALS

LOCATION: 499 George Street, Prince George, B.C., Canada
COMPLETION DATE: October 2014
OCCUPANCY TYPE: Office space; university academic programs
CONSTRUCTION COST: 25.1 million CAD
TOTAL FLOOR AREA: Approximately 4,795m^2
NUMBER OF LEVELS: 6 with a mezzanine level and a rooftop mechanical room

TECHNICAL RESOURCES + LINKS

Technical details of the building systems can be accessed through the following resources:

University of Northern British Columbia Engineering *http://www.unbc.ca/engineering/wood-innovation-and-design-centre*

FPInnovations (2014). Technical guide for the design and construction of tall wood buildings in Canada *https://fpinnovations.ca/Extranet/Pages/AssetDetails.aspx?item=/Extranet/Assets/ResearchReportsWP/E4864.pdf*

Mgb ARCHITECTURE + DESIGN (2012). The case for tall wood buildings *http://cwc.ca/wp-content/uploads/publications-Tall-Wood.pdf*

TECHNICAL SUMMARY

STRUCTURE

- CLT for elevator core, stair core and mechanical shafts.
- Glulam columns and beams; self tapping screw and Pitzl connectors.
- CLT lapped 5 and 3 ply floor panels with screw and HBV connections; concrete topping on the roof deck only.
- LSL ledgers.
- LVL structural mullions.
- LVL main entrance canopy.

SYSTEM INTEGRATION

- Use of mechanical and electrical chases within the floor system.
- Minor penetration in rated assemblies sealed with fire rated caulking.
- Isolated mechanical systems in the rooftop mechanical room.

LATERAL RESISTANCE

- CLT core.
- Floor diaphragms: CLT panels with HBV connectors.
- Floor diaphragms to core: screwed connections through ledgers.

ACOUSTICS + VIBRATION

- Gaskets under interior demising walls on CLT floor panels.
- Acoustic padding under wood flooring at levels 3 to 6.
- Concrete topping at roof level.

FIRE PROTECTION

- Fire resistance rating based on reduced cross section method, sound engineering judgement and comparison of existing test results.
- In-tumescent coating on inside surfaces of elevator core, mechanical shafts and interior walls of roof-top mechanical room.
- Fire rated caulking in penetrations through fire-rated floors and core walls and at panel to panel connections.
- Sprinkler system throughout including viewing window to laboratory at lobby.
- Smoke detectors.

MOISTURE PROTECTION + DURABILITY

- Permanent moisture sensors at key locations in ceilings and walls.
- Char treated wood exterior cladding elements.
- Hording to enclose building for winter construction.
- Rain screen within exterior wall assembly.
- Concrete topping at roof level.

Venting windows in upper half of building
Photo Credit: MGA

Ledger beam supporting CLT floor panels
Photo Credit: Paul Alberts

Services in chases, with penetrations through fire-rated CLT floor system
Photo Credit: Paul Alberts

Natural and charred western red cedar siding
Photo Credit: Brudder

LESSONS LEARNED

OWNER / DEVELOPER

- A persistent approach with a clear objective during the concept development and construction stages was needed to achieve the vision.
- An adequate budget is necessary for being an early adaptor of an innovative structure built under challenging climatic conditions.
- Adopting a P3 framework for the management of the design and construction facilitated all parts of the process from planning to construction completion.

DESIGN TEAM

- Appealing and innovative buildings can be created by utilizing modern design techniques with readily available engineered and traditional wood products.
- Without the alternative solutions approach as allowed by the B.C. Building Code, several of the innovative wood solutions in this project would not have been possible.

AUTHORITY HAVING JURISDICTION

- The regulatory authority can accept a level of risk when an experienced project design team, a capable peer review group and a resourceful general contractor contributing to the design, evaluation and construction work cooperatively towards the successful execution of the project.

CONSTRUCTION TEAM

- Access to experienced mass timber component suppliers, complementary mass timber products and capable installation crews is key to maintaining construction schedules and minimizing costs.
- Off-site component prefabrication and on-site erection expertise are jointly required to maintain an effective project schedule.
- Education and training of sub-trades prior to working on site are necessary for successful completion of their respective tasks in a mass timber structure.
- Greater efficiency and cost savings could be realized with panelized construction of the building envelope.

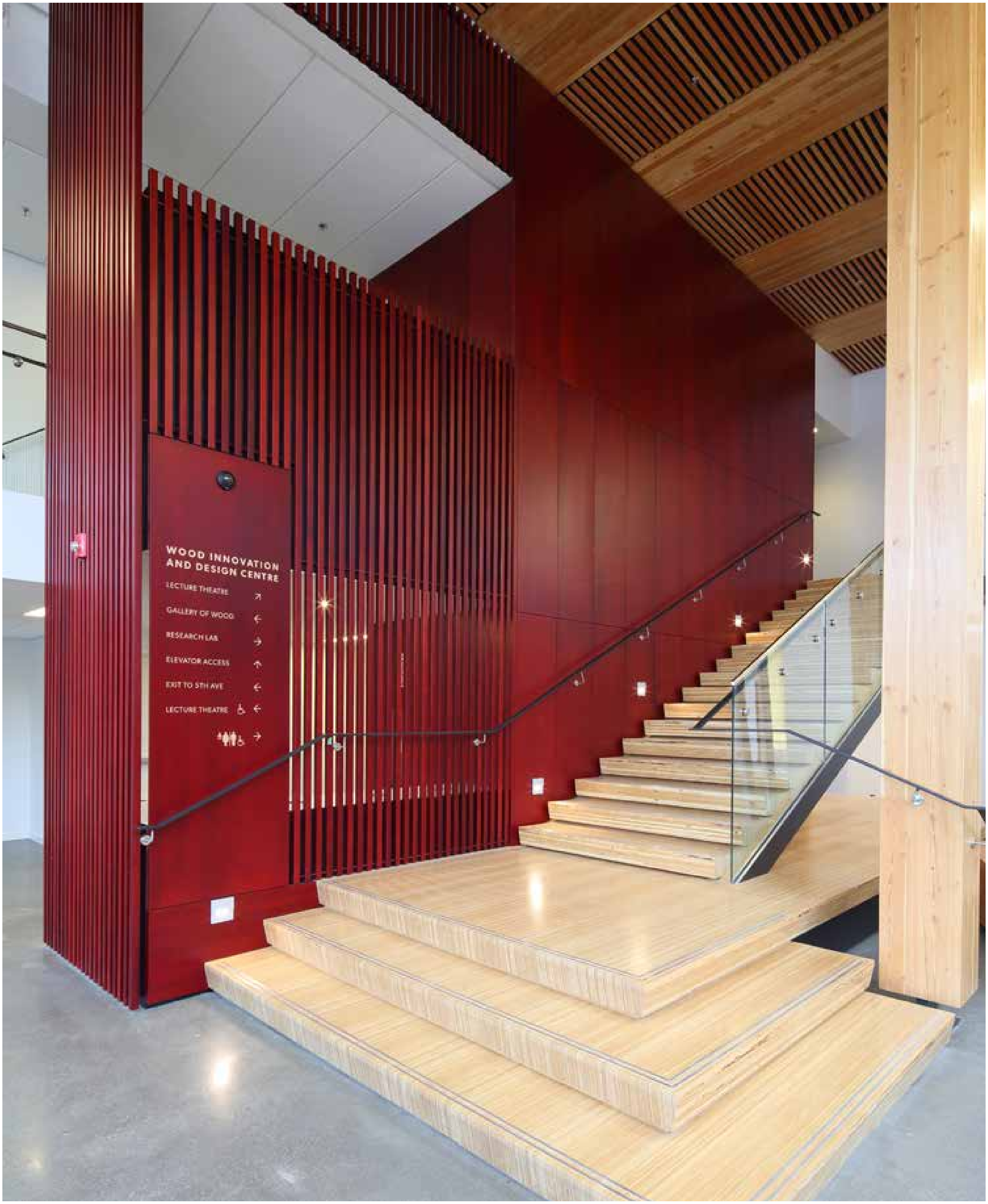


Photo Credit: Ema Peter Photography

THE OWNER / DEVELOPER

THE PROVINCE OF BRITISH COLUMBIA

The Ministry of Jobs, Tourism and Skills Training led the project on behalf of the Government of British Columbia.

RATIONALE

- Support the B.C. Jobs Plan, a government initiative to grow the technical expertise of the province's workforce.
- Showcase B.C.'s expertise in wood design and construction.
- Enhance capacity for innovation related to the forest products sector by investing in a building that utilizes varied wood design solutions; construction and application techniques; and research, education and training opportunities.
- Enhance expertise in wood manufacturing, wood products and international exports in B.C.
- Develop capacity in the engineering sector for building large, multi-use buildings utilizing wood
- Bring together builders, architects, designers and engineers to advance the commercialization of value-added wood buildings and design.
- Amplify B.C.'s expertise and global reputation as leaders in wood construction, engineered wood products and design.
- Support the revitalization of downtown Prince George.
- Build an iconic building that incorporates innovative design, materials and construction.
- Foster collaboration between post-secondary institutions, industry and governments.

PROCESS

- The provincial government identified and appointed Partnerships BC to oversee the WIDC Chief Project Officer and Construction Management functions
- The provincial government confirmed the approach of creating a Site Specific Regulation and a Design Built Solution for the project with the City of Prince George and requested their cooperation.
- The project location was identified and the parcel of land was secured from the original private owner.
- The project design parameters were established by Partnerhsips BC.
- A Ministerial Order providing a site specific regulation was obtained from the Building and Safety Standards Branch.
- An owner's representative multi-discipline project team was established.
- Partnerships BC issued an expression of interests for design-builders to identify suitable proponent teams.
- Partnerships BC requested detailed proposals from short-listed proponent teams.
- PCL Constructors Westcoast Inc. with their design team was selected as the design-builder for the project.

CHALLENGES

- Overcoming scepticism over choice of location and uses of the proposed building.
- Securing the land.
- Assuring the City of Prince George that the project would be feasible and the building would provide equivalent performances.
- Working with many stakeholders or groups to outline and detail the scope of the Ministerial Order.
- Developing the design and specifications of the project while aiming to meet or exceed building performance criteria.
- Selecting a successful proponent from high quality submissions.

SUCCESSES

- The collaborative effort between the provincial and municipal governments led to the selection of a capable design-builder that achieved the project's objectives.
- It was demonstrated that the process could be adopted for future similar initiatives or projects.

THE DESIGN TEAM

MICHAEL GREEN ARCHITECTURE, EQUILIBRIUM CONSULTING INC. and PCL CONSTRUCTORS WESTCOAST INC.

RATIONALE

- Meet the owner's objectives and owner's desire to innovate.
- Create pleasing and cost-effective outcomes.
- Design innovatively to meet or exceed the BC Building Code and the Site Specific Regulation.
- Commit to using renewable materials.
- Consider northern climatic conditions.

PROCESS

- Existing documentation and applications of structural mass timber solutions, innovative connectors and details, and non-structural wood applications that can meet the conditions of the Site Specific Regulation and the Owner/Developers objectives were researched.
- A design objective to maximize the use of wood in structural and non-structural applications was set.
- The code consultants and the builder were engaged to create relevant alternative solutions.
- The alternative solutions were peer reviewed.

Photo Credit: Brudder

DESIGN SOLUTIONS

STRUCTURE

- CLT elevator and stair core shafts combined.
- CLT mechanical shaft.
- Glulam columns and beams with self tapping screw and Pitzl connectors.
- Floor system - CLT lapped 5 and 3 ply floor panels fastened with screws, HBV connections and epoxy; no concrete topping.
- LSL ledgers and beams.
- LVL structural mullions at window openings.
- LVL main entrance canopy.

SYSTEMS INTEGRATION

- Mechanical, electrical and fire protection systems run in chases created from spacing and lapping of CLT floor panels.
- Limited minor penetrations in fire-rated floor and wall assemblies.
- Mechanical systems located and isolated in the roof-top mechanical room.

LATERAL RESISTANCE

- CLT panels forming the elevator and stair core walls.
- Connectors in floor diaphragms:
    - self tapping screws for panel-to-panel and panel-to-ledger connections
    - imbedded Pitzl anchors for beam-to-column connections
    - wood-concrete composite system connectors (HBV connectors) and epoxy between overlapped 3-ply and 5-ply CLT floor panels.

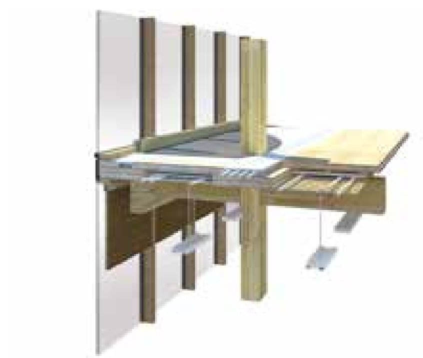
ACOUSTICS + VIBRATION

- Gaskets were installed under interior demising walls on CLT floor panels.
- Acoustic padding was placed under wood floor coverings at levels 3 to 6.
- Instrumentation was installed and is being monitored by FPInnovations.
- A concrete topping was poured on the roof to act as a damper.

FIRE PROTECTION

- The fire resistance ratings for the floors and walls were determined using reduced cross section method, sound engineering judgement and comparison of existing test results.
- In-tumescent coating was applied to the inside surfaces of elevator core, mechanical shafts and interior walls of roof-top mechanical room for additional protection.

Services installed in the chases within the floor assembly
Photo Credit: Paul Alberts



Detail of CLT floor panel system
Rendering: MGA

Gasket under interior wall
Photo Credit: Paul Alberts

Glulam columns and beams in foyer
Photo Credit: Brudder

FIRE PROTECTION (CONTINUED)

- Fire rated caulking was applied in penetrations through fire-rated floors and core walls, at panel-to-panel connections of the floors, and at other panel-to-panel interfaces.
- An enhanced sprinkler system is installed.
- The window for the viewing area between the main lobby and the laboratory is protected by a designated sprinkler system.
- Smoke detectors are located throughout.
- Venting windows acting as access points for firefighters are built into the exterior walls at key locations in the upper half of the building.
- Scissor stairs are used for egress.

MOISTURE PROTECTION + DURABILITY

- Permanent moisture sensors are installed at key locations in ceilings and walls and are monitored by a research institute.
- The outer surface of the Western Red Cedar exterior cladding was manually charred.
- A rain screen is incorporated within exterior wall assemblies.
- A concrete topping is poured on the CLT panels at the roof level.

CHALLENGES

- Meeting owner's objectives of application of innovative wood solutions.
- Meeting the requirements of the Site Specific Building Regulation and the peer review process.
- Creating designs, details and specifications that would meet constructability and project timelines.

SUCCESSES

- The number of constructability issues was minimal given the variety of mass timber building materials used in non-typical ways.
- The site specific regulation was met.
- The architectural design that did not require a poured concrete topping on the CLT floor was accepted.
- The total building height was maximized while maintaining the required maximum number of storeys.

Installation of CLT wall panel against CLT lapped floor panels
Photo Credit: Paul Alberts

Scissor stairs used for egress
Photo Credit: Ema Peter Photography

Monitored sensor
Photo Credit: Paul Alberts

Roof in Foyer
Photo Credit: Brudder

THE AUTHORITY HAVING JURISDICTION

BC BUILDING AND SAFETY STANDARDS BRANCH AND CITY OF PRINCE GEORGE

To better manage the risk associated with the WIDC project, The Building and Safety Standards Branch of the Ministry of Energy and Mines drafted a Site-Specific Building Regulation (SSBR). The SSBR is an exemption from certain requirements of the current BC Building Code and project specific code requirements. The Design Builder was required to meet both the non-exempted requirements of the BC Building Code and the requirements of the SSBR.

RATIONALE

- Support the provincial government's policy and objectives with a regulation that can provide options without compromising structural integrity and safety for the building.

PROCESS

- Additional product and assembly tests were requested to demonstrate the fire performance level and characteristics of the fire-rated caulking.
- All proposed innovative details and assemblies that are beyond the prescriptive requirements of the building code were required to be peer reviewed.
- Construction of the innovative details and assemblies was reviewed regularly by the peer reviewers and recorded with completion of compliance reports.
- The owner's representative project team inspected and signed off on the construction of the building and reported to the owner and the authority having jurisdiction.

CHALLENGES

- Finding ways to share the responsibilities of reviewing and accepting innovative design and construction solutions.
- Setting up a procedure that would allow review of changes to accepted solutions during construction.

SUCCESSES

- A mutually agreed sharing of responsibilities was achieved between the two authorities.

THE CONSTRUCTION TEAM

PCL CONSTRUCTORS WESTCOAST INC.

The construction team interacted with the design team including the code consultant early in the design development process and through the refinement of the design and construction.

RATIONALE

- Utilize the project as an opportunity to apply mass timber buildings technologies and construct a building that is designed outside of the normal use of materials and methods and learn from the experience.

PROCESS

- Applied to the expression of interest.
- Proposed solution through the request for proposals process.
- Negotiated a satisfactory agreement with the owner's representative.
- Evolved the design for constructability and cost efficiency.
- Educated and contracted suppliers and sub-trades.
- Worked with the owner's representative project team.

Photo Credit: Paul Alberts

CONSTRUCTION SOLUTIONS

STRUCTURE

- Prefabrication of CLT panels and glulam elements with precision detailing for fastenings and penetrations.

SYSTEMS INTEGRATION

- Utilized the mechanical shaft and floor chases to accommodate all services where possible.

FIRE PROTECTION

- Charring of the exterior western red cedar cladding was performed off-site.

MOISTURE PROTECTION + DURABILITY

- Scaffolding and hoarding were set up to enclose the entire building to facilitate construction in the winter.
- Panels and beams were wrapped for delivery to site and, where possible, glulams remained wrapped until enclosed.

Glulam beam with steel connector
Photo Credit: Paul Alberts

CLT mechanical shaft
CLT Photo Credit: naturallywood

Hoarding for moisture protection
Photo Credit: Paul Alberts

CHALLENGES

- Construction delays caused by heavy snowfalls and extreme cold temperatures.
- Matching material supply, fabrication schedule and construction sequences.
- Adapting known solutions to first-time wood assembly applications:
  - caulking in penetrations and at panel-to-panel interfaces
  - elevator rail connections to CLT shaft panels
- Developing routing options for the electrical and fire protection systems utilizing the one-directional chases in the floor assembly.
- Dealing with the high frequency of requested tours of the site.

SUCCESSES

- Reliable, skilled, adaptable and cooperative trades available locally.
- Project completed on time and on budget.
- First-hand knowledge gained of an alternative solution process involving engaged peer reviews.
- Lower operational time for the use of the overhead crane.
- Significant reduction of concrete pours and fewer overall lifts associated with mass timber construction.

Photo Credit:Paul Alberts