REACHING NEW HEIGHTS

KK LAW, COURTESY OF NATURALLY:WOOD

THE WORLD'S TALLEST CONTEMPORARY MASS TIMBER BUILDING IS NEARING COMPLETION IN VANCOUVER, PRESENTING A PRAGMATIC ARGUMENT FOR HOW MASS WOOD CAN BE USED FOR ALL TYPES OF BUILDINGS, FROM THE AUDACIOUS TO THE EVERYDAY.

PROJECT Brock Commons Tallwood House, University of British Columbia, Vancouver, B.C.
ARCHITECT Acton Ostry Architects Inc.
TEXT Bruce Haden
PHOTOS Acton Ostry Architects Inc. & University of British Columbia, Pollux Chung, KK Law, and Steve Enrico, as noted

The new Brock Commons student residence at the University of British Columbia will be the tallest contemporary mass timber building in the world when finished this May. The term "mass timber" or "mass wood" covers an array of approaches, usually referring to a structural system combining engineered wood columns and floor slabs. In Canada, the most commonly referenced technical innovation, and one of the ones behind Brock Commons' structure, is the cross-laminated timber (CLT) slab, available in a variety of thicknesses for different span requirements.

While Brock Commons' height will unquestionably get the lion's share of attention after its completion, that's not the most interesting thing about the building for architects. Rather, it is the fact that, on typical floors, the wood is not visible.

Acton Ostry Architects principal Russell Acton, FRAIC, the lead designer of Brock Commons, has lectured widely on the project. When he talks to architectural audiences, he is inevitably asked: "why didn't you expose the wood?" The answer is that the wood structure has been encapsulated in drywall and concrete topping to ensure efficient code compliance.

This pragmatic approach was a response to achieving quick approvals, and as an associated outcome, addressed perceptual challenges in terms of fire safety. In fact, the historic (and completely understandable) fear of fire in wood frame buildings is dramatically less relevant to mass timber. During a fire, the outside surface of a thick wood member chars while protecting a structural core of unburnt wood. As building codes develop, it is likely that the testing of mass wood assemblies will assist authorities to better understand the inherent fire resistance of mass timber, and potentially reduce the need for encapsulation, provided that a sacrificial layer of wood char is provided in its place.

However, we are not there yet. For Acton, the conservative approach chosen for Brock Commons may help lead to a future where the use of CLT is more commonplace. Brock Commons models a way that multi-residential builders can use CLT as an affordable and efficient means of building development projects, the vast majority of which are created without the involvement of architects. Acton sees a future of "mass wood for the masses."

Broad adoption of mass wood structures, whether tall or not, would be a sustainability win. Advocates such as Vancouver architect Michael Green, FRAIC, an early leader in promoting mass timber, argue that the carbon sequestering properties of mass wood confer an extraordinary environmental benefit. According to a 2014 article in the Journal of Sustainable Forestry, substituting wood for current construction materials could save 14 to 31 percent of global carbon dioxide emissions.[1]

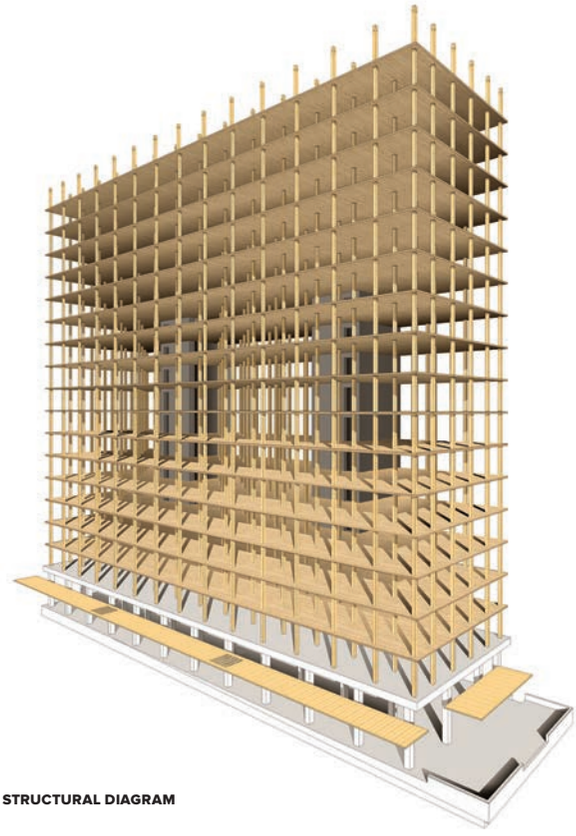
ACTON OSTRY ARCHITECTS INC. & UNIVERSITY OF BRITISH COLUMBIA

POLLUX CHUNG, COURTESY OF SEAGATE STRUCTURES LTD.

STEVE ENRICO, COURTESY OF NATURALLY:WOOD

OPPOSITE Seventeen storeys of Brock Commons are built with a hybrid structure that includes prefabricated glulam columns and CLT floor slabs. The structure was erected at a rate of two floors per week. **ABOVE, CLOCKWISE FROM TOP LEFT** Prefabricated façade panels, including windows, helped speed the construction process; glulam columns are tilted into place on a CLT floor slab; a typical floor, as seen before the glulam and CLT were encapsulated with drywall to facilitate the approvals process.

KK LAW, COURTESY OF NATURALLY:WOOD



STRUCTURAL DIAGRAM

ABOVE, LEFT TO RIGHT A CLT floor slab is lowered into place and fastened to the glulam columns; the hybrid structure is primarily wood but also includes a concrete ground floor and core; even though mass timber has inherent fire resistance, the glulam and CLT were encapsulated with drywall to facilitate approvals, and a concrete floor topping was added for acoustic protection.

Skeptics note that a substantive transformation of building construction would require a strong global culture of sustainable forest management. Although there are important examples of responsible forestry around the world, there are far more examples of short-term cut-and-run management of the world's trees. Nonetheless, the lightness of mass timber, its ability to reduce the emissions generated by concrete and steel production and construction where appropriate, and the opportunity to nurture an advanced Canadian wood industry are all clear benefits.

Green also speaks with passion about the visual warmth of wood, and people's visceral pleasure in wood as an emblem of the natural world.[2] For him, the inherent fire safety advantages are as yet under-recognized by building code officials, and the visibility of the wood bones of a mass timber building is a central benefit.

A related debate in the global tall wood movement is about how much of the structure can efficiently be built in wood, whether exposed or not. Paul Fast of Fast + Epp, the structural engineers for Brock Commons, believes in optimized solutions that maximize the benefits of each material. For example, he notes that the decision to use steel studs in Brock Commons' envelope was related to lightness, consistency and the accuracy of the precut perforations.

More serious was the decision to have a concrete core as opposed to a wood core. There was a precedent for a wood core: the Wood Innovation Design Centre in Prince George, B.C. (by MGA with structural engineer Equilibrium) has one. But for UBC, Acton Ostry and their Austrian advising architect, Hermann Kaufmann, determined that the most important contribution to advancing the use of mass timber was in having a completed building delivered on-time and on-budget. The unknowns in having a "purist" wood structure, including the core, outweighed the advantages. A particular risk was the potential delay in building approval. For Acton and Kaufmann, "the evolution of tall wood buildings is in its infancy; over time, small advances will lead to big changes."

It would be a great win if mass wood products were both visually celebrated *and* the go-to for the unadventuresome spec builder. Ultimately, the question "why didn't you expose the wood?" speaks to architects' strong bias towards the visual—but it avoids the central question of how to best make tall wood buildings commonplace. No one ever asks why you can't see the 2x4s in conventional wood frame construction.

If the completion of Brock Commons sets the stage for an equally tall—or taller—mass wood building that has no concrete above the ground level, and where the structural material is visible throughout, that would be a positive milestone. If that future pure wood tower gets built in Canada, so much the better. ◖▲

Bruce Haden, MRAIC is a Vancouver-based architect and urban designer. He was formerly a principal at DIALOG and its predecessor, Hotson Bakker Boniface Haden Architects + Urbanists.

[1] Oliver, Nassar, Lippke & McCarter. "Carbon, Fossil Fuel, and Biodiversity Mitigation with Wood and Forests." *Journal of Sustainable Forestry*, Dec. 2013, pp. 248-275.

[2] www.ted.com/talks/michael_green_why_we_should_build_wooden_skyscrapers

CLIENT UNIVERSITY OF BRITISH COLUMBIA | **TALL WOOD ADVISORS** ARCHITEKTEN HERMANN KAUFMANN ZT GMBH | **ARCHITECT TEAM** RUSSELL ACTON, MARK OSTRY, MATT WOOD, GJERGJ HONDRO, SUSAN OCKWELL, RAFAEL SANTA ANA, WARREN SCHMIDT, NEBO SLIJEPCEVIC, NATE STRAATHOF, SERGEI VAKHRAMEEV, ANDREW WEYRAUCH | **INTERIORS** ACTON OSTRY ARCHITECTS INC. | **STRUCTURAL** FAST+EPP | **MECHANICAL/ELECTRICAL** STANTEC | **LANDSCAPE** HAPA COLLABORATIVE | **PROJECT MANAGER** UBC PROPERTIES TRUST | **CONSTRUCTION MANAGER** URBAN ONE BUILDERS LTD. | **WOOD STRUCTURE ERECTION** SEAGATE STRUCTURES LTD. | **FORMWORK** WHITEWATER CONCRETE LTD. | **PREFABRICATED FAÇADE** CENTURA BUILDING SYSTEMS LTD. | **LEED** STANTEC | **FIRE SCIENCE AND BUILDING CODE** GHL CONSULTANTS LTD. | **BUILDING ENVELOPE** RDH BUILDING SCIENCE INC. | **VIRTUAL DESIGN MODELLING** CADMAKERS INC. | **ENERGY MODELLING** ENERSYS ANALYTICS INC. | **ACOUSTICS** RWDI AIR INC. | **CIVIL** KAMPS ENGINEERING LTD. | **AREA** 15,115 M^2 | **BUDGET** $51.5 M (PROJECT BUDGET) | **COMPLETION** MAY 2017

DETAIL

TECHNICAL FICHE

MANDATE: According to John Metras, Managing Director of Infrastructure Development for UBC, the university wanted to "use advanced wood-based building systems to demonstrate the applicability of wood in B.C.'s development and construction industries." The project also needed to allow for ongoing monitoring to provide detailed knowledge that will support future changes to the National Building Code.

PROGRAM: The building houses 404 upper-year and graduate students in a total of 305 units (272 studios and 33 quads). It includes both ground-floor and top-floor lounge and support spaces. UBC has recently built multiple student residences, and was clear about the unit layout they wanted. Accordingly, this was a largely predetermined aspect of the design.

BUILDING HEIGHT: 17 floors of wood structure on top of a single floor of concrete construction.

STRUCTURE: The building is a hybrid wood-concrete structure, combining glulam wood columns and CLT floorplates with a concrete core. The small sizes of the housing units allowed for a highly repetitive structural grid of 4 metres by 2.85 metres. The short structural spans allow for the CLT to span in two directions in lieu of beams. The 5-ply, 169 millimetre thick CLT panels are 2.85 metres wide and 6, 8, 10 or 12 metres long. Columns are 265 x 265 mm glue laminated Douglas Fir to level nine, and 265 x 215 mm for the upper levels. The roof structure is steel.

BUILDING ENVELOPE: Composed of steel stud-framed prefabricated panels. The panels include the windows and are clad in wood pattern Trespa, manufactured with 70 percent wood fibre and thermosetting resins.

EXTERNAL FUNDING: At the project conception, UBC recognized that building the world's tallest contemporary timber building would require additional resources to manage risk and address unknowns. The project obtained funding to cover this "innovation gap" from Natural Resources Canada, the Province of British Columbia, the Binational Softwood Lumber Council and FPInnovations.

BUILDING CODE: The wood structure is encapsulated with three layers of drywall on the underside of the CLT and three- to four-layers on the glulam columns. A concrete floor topping on the CLT is applied for acoustical purposes. Encapsulation is applied in a manner similar to that used for steel, where the required fire protection for the structure is achieved with layers of gypsum board. While, given the inherent fire-resistance of mass timber, this approach could be thought of as a "belt and suspenders" strategy, it helped streamline approvals. As part of the application for a Site Specific Regulation (SSR) to allow this tall a wood building, the provincial Building Safety Standards Branch required that the project be reviewed for technical risks by two Expert Advisory Panels, one focused on fire safety and the other on structural safety. To facilitate the approvals process, the design team proposed just three substitute requirements from the current code: the use of a mass wood structure, encapsulation of the wood structure to achieve the required fire protection ratings, and approval for an exposed CLT canopy. The SSR was granted expediently—less than three months after the team presented to the expert advisory panels.

BUDGET AND COST: The initial target budget was $30 million, or $191 per square foot, the same as the actual built cost for UBC student housing completed just prior to the start of the design of Brock Commons. This was a stretch target, and would have been lower than actual market construction cost for a similar concrete building at the time of consultant selection. According to Metras, in 2017, the construction cost for a comparable scale of building with a concrete structure would be $210 to $215 per square foot. He anticipates Brock Commons will be completed for just over $230 per square foot. This is well in alignment with current market costs for this building type. Metras attributes the additional cost relative to concrete construction to the "innovation premium" noted above, and believes it would now be possible to build a similar tall wood building for less than Brock Commons, given the knowledge that has been gleaned from this project. In particular, he notes an opportunity already discussed with building officials to eliminate one layer of drywall from the encapsulation assembly—which would yield a substantial savings of approximately $9 per square foot.

CONSTRUCTION BENEFITS: Carla Fraser, the site supervisor for Urban One Contractors, the Brock Commons builder, is an energetic proponent of tall wood. When I walked through the site with Fraser and Acton, the two independently noted several crucial benefits to mass timber construction. To start, there's the speed advantages of wood. A comparable concrete building would have taken roughly 22 months to build, but Brock Commons will be complete in 18 months. Fraser and Acton said that although the construction team was informed well in advance of the speed that the structure would go up, the mechanical and electrical trades were still caught off-guard by the speed of erection of each floor: two levels of mass timber structure and prefabricated façade were installed each week. Importantly, the wood slab was clear for working immediately post-installation. A concrete slab would have been a forest of shoring until the concrete had set enough to allow the removal of the temporary supports. The offsite fabrication of the glulam columns, CLT slabs, and prefabricated exterior wall panels not only increased the construction speed, it decreased the noise and construction interference to the adjoining properties.