Dramatic Roof Form

The VanDusen Botanical Garden Visitor Centre

BY DUANE PALIBRODA

NIC LEHOUX

The thoroughfare along Oak Street between King Edward and 33rd Avenue in Vancouver has never been a particularly inspiring drive. Motorists funnel past non-descript retail buildings, a hospital, and field hockey players battling it out on an adjacent high school's artificial turf.

But all that changed in the spring of 2011, when cranes, construction workers and flatbed trailers loaded with roof panels rolled onto site at VanDusen Botanical Garden. Now, it seems, passersby can't help but turn their heads.

The crews have just finished erecting the city's greenest building — an iconic new 19,000 sq. ft. visitors' centre — targeting Living Building Challenge and LEED Platinum status. The striking entrance point serves as a welcome portal featuring an interactive education centre, lecture rooms, exhibition space, a cafe, and guest services — all with the intention of revitalizing public interest in the gardens. But it's the dramatic free-form, organically-shaped roof structure that makes people take a second look, as it emerges midway along the tree-lined block. Its form metaphorically represents petals of an orchid, drooping seamlessly into the surrounding landscape like an extension of the garden itself.

It seems fitting that architects at Perkins + Will Canada — a firm long associated with successful wood innovation and green building design — along with their team of engineering consultants, arrived at a sustainable wood solution for the new visitor centre. Coincidentally, the garden gets its name from Whitford Julian VanDusen, a local lumberman and philanthropist whose vision saved the 55 acre parcel of land from residential development in the late 1960s. A graduate of the forestry program at the University of Toronto who later worked for the provincial government in the wood industry, VanDusen felt it important to preserve the grounds for future generations.

While similarly complex building forms — like Spain's Guggenheim Bilbao Museum or the Music Experience Building in Seattle, Washington — have been achieved through the use of steel or concrete, the same results have rarely been attempted with wood. Though the $22-million building and roof structure may have looked seamless on paper, actualizing the design proved a demanding task. Nevertheless, the design team forged ahead. Several of the firms involved were no strangers to the challenges of using sustainably-harvested wood as a primary building material in unconventional circumstances.

Structural engineers at Fast + Epp, in particular, had unearthed new potential for wood construction less than five years prior, when they spanned the six acre roof of the 2010 Winter Olympic Speed Skating Oval with pre-fabricated WoodWave panels. Developed by Fast + Epp's affiliate design-build company Struc-

NIC LEHOUX

tureCraft Builders, the WoodWave technology was formed from economical and abundant 2x4 lumber pieces and incorporated acoustical, mechanical and electrical elements into each panel.

Based on this prior experience at the Oval, Fast + Epp quickly established that similar methods could be applied to the VanDusen project, according to the firm's managing partner, Paul Fast. He says the key to solving VanDusen's complexities was "to simplify, and break it down into bite-sized chunks."

He says pre-fabrication seemed the best option, as thermal insulation, sprinkler pipes, lighting conduits, acoustic liner, and wood ceiling slats could all be pre-installed in the unique roof panels. This holistic approach to design — though somewhat daunting in initial conception stages — meant construction crews would spend less time troubleshooting on site and the potential for water damage would be minimized during Vancouver's inevitably wet months.

Given the project's precedent setting construction techniques and complex geometry, timber construction and pre-fabrication methods seemed the most probable way to meet the project's "almost-impossible" schedule deadlines.

Each of the 71 different roof panel sizes and shapes was informed by the dimensions of the flat deck truck that would transport it to VanDusen from the StructureCraft shop in Delta, B.C. The roof structure modules were typically trapezoidal shaped panels within a 3.6-metre-wide by 18-metre-long shipping size. These panels consist of doubly curved, glue-laminated edge beams that not only act as primary supporting components, but were also ingeniously used as "jig" members on adjustable shoring posts that defined spanning between the complex individual panel geometry during the prefabrication process. Conventional plywood sheathed 2x8 framing spans between the edge glulams, while a secondary layer of light framing forms the support structure for undulating wood slat ceiling finish. Particularly challenging was the framing of large, cantilevered "petal" tips and the central oculus with its steep side walls surrounding a skylight opening, according to Fast.

> ...the building's 50 foot atrium required the development of a universal panel-to-column connection to avoid unique connections at every support location.

Engineers also developed a lateral system to support the heavier mass of the building's green roof, locating steel braces and curving concrete walls strategically, so both the functional layout and breathtaking views of the surrounding garden would remain unimpeded. In addition, the undulating twists and turns of the building's 50 foot atrium required the development of a universal panel-to-column connection to avoid unique connections at every support location.

To aid them in this task, three different high-powered computer modeling programs were used by the architectural, engineering and construction team. This software — Rhino, Revit and Inventor — developed the multifaceted geometrical shape and each individual building component. This three-dimensional technology ensured accurate in shop assembly and precision fits when the pieces later arrived on site.

The resulting building is a testimony of the 'A-Game' that architects, engineers and builders brought to the table — in some ways, a lasting tribute to the man who fought to save the gardens. **CB**

Duane Palibroda, P.Eng., Struct Eng., M.I.Struct.E., LEED AP, is the managing associate at Fast + Epp Structural Engineers in Vancouver. His project experience includes numerous award-winning public, institutional, transportation and residential works in Canada and the United Kingdom.