

## THIS ENGINEER'S DEDICATION IS HELPING EVOLVE ONTARIO'S BUILDING TECHNIQUES

Structural engineer Mary Alexander, MEng, P.Eng., channels hard work into pioneering tall-wood structures in the province.

By Adam Sidsworth



Mary Alexander, MEng, P.Eng., is a structural engineer at Moses Structural Engineers, where she is at the forefront of tall-wood structures.

When Mary Alexander, MEng, P.Eng., first pondered her post-secondary education, she was a student at the Etobicoke School of the Arts. She studied music and majored in the double bass, but on top of her busy schedule, "I was...maintaining my average [and] doing school sports teams and working part-time coaching gymnastics," Alexander says. "Having a busy schedule was a really good way to organize my time and prioritize. I graduated with the third-highest average in the school." Still, Alexander was unsure. "I did well in music; I did well in sports; I did well with academics, but what am I going to do with a career for myself? One of my teachers told me, 'If you look at what you did as a small child, that's what you typically do as an adult.'" As a kid, Alexander "really enjoyed playing with DUPLO, a large type of LEGO that kids can't swallow. I'd build houses...with my kid brother and teach him how to play with

it properly: The blocks have to interlock. And I thought, 'I should do something with structures,' so I started to put together a portfolio" with an eye on becoming an architect. But Alexander wasn't sure if her portfolio would be sufficient. "So, I went to the guidance counsellor, and that's when she mentioned engineering, and I gave her a blank stare," Alexander says. "I didn't know what engineers did. And she said, 'Engineers use applied math and science to solve problems and create solutions,' and I said, 'Bingo! That's what I want to do!'"

Alexander chose civil engineering at the University of Toronto (U of T) because "it covers the whole spectrum, and it's not until fourth year that you choose [specialized] courses." Alexander purposely chose courses in various streams of civil engineering in order to develop a broad engineering perspective, and at the end of her undergraduate degree, Alexander completed an internship placement with Moses Structural Engineers, a Toronto firm that specializes in structures made principally from wood. Alexander felt at home, noting the firm's small size and sense of family. By the end of her internship, Alexander was accepted into a master's degree in civil engineering, with specialization in structural engineering, at the U of T, and she felt welcome at Moses. "In my heart I really wanted to return, and, of course, on my last day, my boss said, 'If you're free during school, we'd like to have you come in part-time, and then we could take you full-time once you're done school,' and I was just in heaven," she explains. "They're a close-knit family, so once they find somebody who fits in with everybody...they like to keep them." She had only a week off between her internship and her master's program, and once she finished her master's she had only three days off before starting full-time at Moses. (She used those three days to move in with her then-fiancé and now-husband, a carpenter.)

### DEVELOPING A SPECIALTY

Through her master's degree, Alexander took specialized classes, such as earthquake engineering and structural building systems, which aren't necessarily offered at the undergraduate level, and Alexander tailored her education towards working with a variety of materials—including concrete, prestressed concrete, steel and precast systems. Once Alexander completed her master's, she returned to Moses full-time, and because of the firm's small size, she was able to work on projects from beginning to end. Alexander has been able to develop a specialty, especially since the province's 2015 amendment of the Ontario Building Code allows buildings of up to six storeys to be built out of principally wood. In fact, because of her expertise, Alexander co-authored the guide *Ontario's Tall Wood Building Reference* with Moses Structural Engineering principal David Moses, PhD, P.Eng., and CHM Fire Consultants Ltd. for the Ministry of Natural Resources and Forestry. "In the [building] code, we can go only up to six storeys, but there's nothing really stopping us from going over," Alexander asserts. "With tall timber (over six storeys), one example of mass timber

is cross-laminated timber, which is made up of three, five, seven or nine layers of dimensional lumber that are laminated together. The layers alternate in direction, crisscrossing at 90 degrees. It improves the strength and stability of the member, since you get the strong axis of the wood situated in both directions.”

However, Alexander notes that there are limitations, such as stair shafts, which must be made of non-combustible materials; and elevator shafts, which in Ontario aren't necessarily built from wood due to suppliers' preference. (Wood is also more susceptible to shrink, presenting a challenge when building fire shafts, which, at six storeys, must be made from non-combustible materials.) Alexander also co-authored the 2017 *Ontario Wood Bridge Reference Guide*, again with Moses, along with other engineers from her firm and Brown & Co., a firm that specializes in bridges, including wood bridges, for the provincial Ministry of Natural Resources and Forestry and the Canadian Wood Council. “When you see a wood bridge, it's usually a pedestrian wood bridge in a park,” Alexander says. “But guess what? You can build a wood bridge for highways. It's done all through Europe and BC and throughout the United States.” However, Alexander suspects that most Ontario engineers stick to man-made materials due to familiarity.

Her expertise in co-authoring the documents came from her background research in building tall-wood buildings. Alexander has since incorporated into her work helping people who work with wood but don't necessarily have experience working on taller structures. “You want to make it clear to read for somebody who's worked with wood but hasn't done a six-storey building,” she says. “I worked with [Local 27 Carpenters and Allied Workers, a trade union]...and put together a six-storey module to show them all the connections with wood.”

#### AWARD-WINNING WORK

Alexander's proudest moment, though, is working on the Brampton, ON, Saint Elias the Prophet Ukrainian Catholic Church restoration. The original church burned in a fire, and Alexander engineered many of the structural elements, including the church's five Boyko domes—the largest of which weighs over 18,000 kilograms—typical of Ukrainian-style architecture. “We used glulam,” Alexander explains. “[It's] a dimensional wood lumber laminated together...because trees come only so big.” On the outside, they used cedar. Alexander was filled with awe when she visited the site. “Everything was huge...I'm used to going on-site, where everything is dirty, but this site was very clean. You could smell the fresh-cut cedar lumber,”



Exterior and interior views of Saint Elias the Prophet Ukrainian Catholic Church in Brampton, ON, complete with its wooden Boyko domes, which Alexander engineered.

she reminisces. “It's so nice that you forget that you're supposed to be reviewing the installation. But it's so stunning on the inside, and they kept with the tradition of the original church.” The church ultimately won the 2016 Wood Works! Institutional-Commercial Wood Design Award <\$10 million. It's projects like this that make Alexander, who is just finishing up a year-long parental leave, eager to get back to work. **e**