Photo by: Maggie Cadeau

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SPECIAL FEATURE

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Creative concrete: B.C. artist specializes in concrete forms

PETER KENTER
CORRESPONDENT

Concrete has become synonymous with its massive brute presence. It takes a committed artist to tease grace and beauty from its strength. It's all in a day's work for Trent Hutton, the British Columbia-based artist behind Wavestone Sculpture, a boutique studio specializing in public art, play structures and rock habitat environments for public institutions, corporations and private clients around the word.

Hutton began sculpting for a commercial studio in Toronto. He later moved to the Lower Mainland where he began to specialize in artificial rockwork using concrete. He founded Wavestone on Bowen Island about 15 years ago.

"I was primarily creating custom rockwork such as retaining walls, cliffs and waterfalls," says Hutton. "It's a specialized form of sculpture because you're not just recreating natural rock, but replicating specific types of rock—most commonly granite and basalt in British Columbia. The client typically wants to replicate the rock already found in the area. I built an amazing oceanfront indoor grotto at a private residence in the Grand Cayman Islands to replicate local limestone."

He's produced rock sculptures for clients including the Telus World of Science, Vancouver International Airport, and the Vancouver Aquarium.

Among his other projects; public art; play sculptures; zoo and aquarium habitats; spa and pool rocks; retaining walls and public furniture.

While his projects are occasionally fashioned in the studio, 90 per cent of the work is completed on site, simply because it's integral to the location where it's installed.

Hutton works primarily in concrete applied over geotechnical foam using a selection of hand tools. The work is almost universally sculpted and rarely cast.

"When I think of casting, I think of chocolate or gold," he says. "It's such a different process from carving and sculpting by hand. I don't like to cast concrete because most of my work is original and not designed to be replicated."

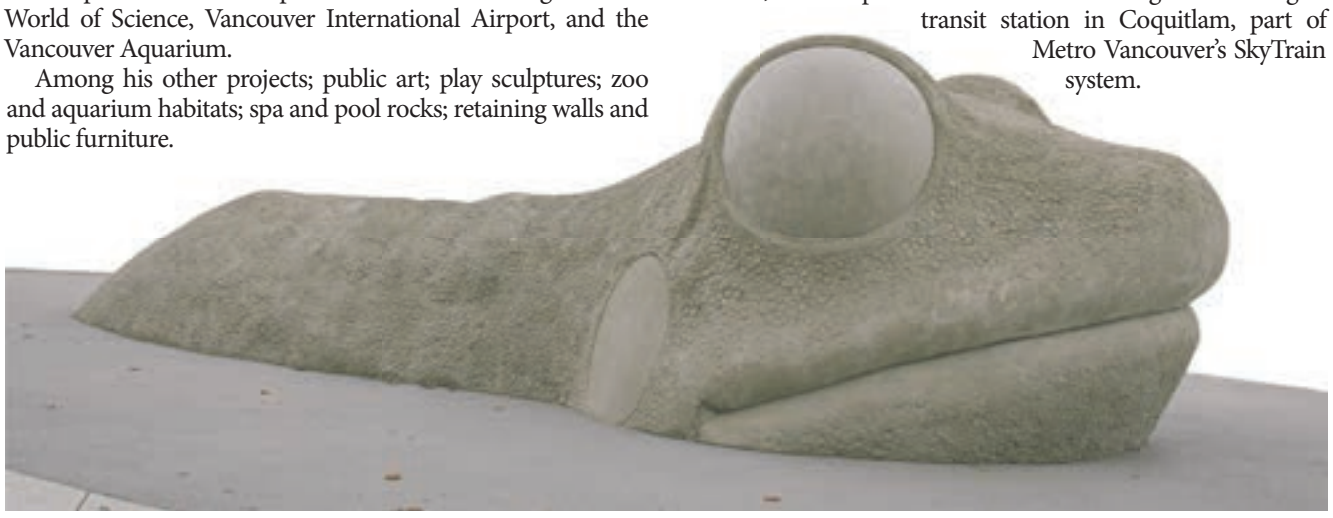
One of his most unusual private projects is a literal "man cave." It's a media room in a private residence in Langley.

"It was the owner's dream to create a home theatre that looked like an underground cavern," he says. "It was built complete with lanterns, coal mine carts, timber supports and a wine cave cellar. The rock walls had resin dinosaur skulls imbedded in them."

He also sculpted a series of concrete trees displayed at B.C. House at the 2010 Winter Olympics.

But Hutton's greatest love is now public art.

His first public art project was TransLake, a 21-foot concrete sculpture featuring a frog emerging from the water. Completed in 2016, the sculpture sits outside the Lafarge Lake-Douglas transit station in Coquitlam, part of Metro Vancouver's SkyTrain system.



PHOTOS BY WAVESTONE SCULPTURE

Trent Hutton is the British Columbia-based artist behind Wavestone Sculpture. Hutton works primarily in concrete applied over geotechnical foam using a selection of hand tools.

"Lafarge Lake was a gravel quarry that was once owned by Lafarge, a manufacturer of concrete, and given to the town in the 1980s," says Hutton. "It's now transformed into parkland and home to many species of wildlife. The emerging frog represents metamorphosis — the transformation of industrial lands back to something green. It's a great story that inspired the project."

Hutton worked on the sculpture for more than 120 hours. He says he not only enjoyed producing the work, he's inspired by watching people interact with it. Climbing on the sculpture is not only acceptable, it's encouraged.

His most recent commission is the Horse and Foal Play Sculpture, which received its official opening in May 2018 at Burke Mountain Pioneer Park in Coquitlam.

"The park wanted a unique piece of play equipment that wasn't made of typical fibreglass or plastic," he says. "I designed it to be safe for play by softening and curving the edges and setting it in a resilient rubber floor. The project is a new concept for play equipment and definitely part of the direction in which I want to take the company."

Although he occasionally hires from a select group of freelance artists to assist with large projects, he prefers to create most of the work himself.

"I don't want to have the work created by someone else in my name," Hutton says. "I want to be the artist — to keep on the tools, sculpting and doing the fun stuff."

Alberta researcher developing earthquake-resistant concrete

PETER CAULFIELD
CORRESPONDENT

One of the worst natural disasters in U.S. history took place early on a January morning in 1994, when a 6.7 magnitude earthquake occurred 20 miles north of downtown Los Angeles.

Fifty-seven people were killed, and almost 9,000 others injured. Property damage was estimated at up to $50 billion.

The Northridge earthquake, as it came to be known, gained worldwide attention because of the extensive damage it caused to the region's freeway network.

Surface roads were clogged for three months while the freeways were repaired.

"The 1994 Northridge earthquake is one of the most important ground motions in North America," said Mohammad Javad Tolou Kian, who is researching high-performance reinforced concrete walls that possess improved damage properties that protect them when an earthquake strikes.

"Because even well-designed structures suffer permanent deformations and concrete damage when withstanding strong ground motions (such as seismic events and earthquakes), a structure which suffers limited damage will be of great benefit," he said.

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Canadian hemp fibre concrete additive Winter Olympics 2022 bound

PETER KENTER
CORRESPONDENT

After years of research, Calgary's Canadian Greenfield Technologies developed NForce-Fiber, a hemp fibre concrete additive specified to both strengthen concrete and reduce cracking. The product has become so successful that it was recently specified to help create a smooth and stable run for competitors at the Xiaohaituo Bobsleigh and Luge Track near Beijing, China for the 2022 Winter Olympic Games.

The company was founded in 2012 by president Mike Pildysh, a structural engineer and building industry veteran, to focus on developing concrete reinforcement products designed to reduce early-stage cracking within the first 72 hours.

"If you ask people in the construction industry whether plastic, steel or glass fibres work successfully to mitigate concrete shrinkage cracking, they won't answer enthusiastically," says Stephen Christensen, vice president and general manager of Canadian Greenfield Technologies. "Steel isn't often used because it's expensive, while glass is primarily used in decorative concrete products. The most commonly used fibre is plastic, which is hydrophobic in that the fibres would rather stick to the trowel than bond with the concrete. The fibres also protrude, making the product difficult to finish."

The company conducted extensive research on a range of more effective additives and found that natural fibres led the pack.

"The strongest natural fibre just happened to be hemp," says Christensen. "It bonds physically and chemically with the concrete and it will break before it pulls out to affect surface smoothness."

Farmers in southern Alberta grow the hemp, which is raised primarily for seeds. However, Canadian Greenfield Technologies wasn't happy with traditional methods of "decortication" — separating the woody "hurd" found in the core of the stalks from the useful "bast" found on the exterior.

"It's typically achieved using 100-year-old technology called the hammermill," says Christensen. "It consists of smashing the stalks against a grating using hammers until the hurd is forced through. However, that's really damaging to the fibre. We developed proprietary machinery for decortication that keeps the fibre coarse and strong. The technology is very robust to feedstock, so we can take various strains of industrial hemp and produce a similar fibre product at the end."

The fibre is also treated for compatibility with concrete, so that it doesn't break down, absorb too much moisture or alter mix design to affect parameters such as flow, compressive strength or air entrainment.

CANADIAN GREENFIELD TECHNOLOGIES

Calgary's Canadian Greenfield Technologies has developed NForce-Fiber, a hemp fibre concrete additive specified to both strengthen concrete and reduce cracking.

RUSTY MORGAN (2017)

NForce-Fiber was used in the building of the Tulista Park skate park in Sidney, B.C.

NForce-Fiber was launched in 2015. The product is supplied in one-pound bags designed to be thrown into wet or dry concrete mixes bag and all at three to four pounds per cubic metre. Its partner product NForce Pro is designed to supply the decorative concrete market, where mixes typically contain less aggregate. Because decorative concrete encompasses a wide range of proprietary mixes, the company simply specifies that the hemp fibre be added at half the weight of glass fibre typically used in these mixes.

"The product can also be added to shotcrete, which solves the problem of fibre flying out of the mix while it's being shot," says Christensen. "It's very pumpable and adhesive, so you could spray bands of up to eight feet tall at one time, without having the product settle."

Clients have used the additive for a range of projects where cracks are unforgiving. These include pools, skate parks and decorative projects. The largest project to date is a British Columbia skate park, which will use about 800 lbs. of the additive.

"Construction can be a conservative industry and concrete is dominated by some very large players, so it was challenging to break into the market," says Christensen. "Third-party testing by reputable firms went a long way to help us gain acceptance."

It was third-party testing that led to a recommendation to specify the product for the 2022 Olympics.

"They typically don't use fibre in bobsled tracks because they require such highly-finished surfaces and the fibres protrude," says Christensen.

"We were originally recommended but turned down as an unknown technology. The selected mix design was then trialed and it cracked like crazy. When they tried the fibre that we sent along, those problems went away. We recently sent the first shipment of 360 lbs. of NForce-Fiber to China, which is definitely a feather in our cap."

Study finds fibre reinforcement mitigated damage to concrete

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Tolou Kian, who is a PhD candidate in structural engineering at the University of Alberta, says that, since Northridge, there have been numerous studies on the different types of damage that was sustained by structures during the earthquake.

"The studies have led to significant changes in the construction of earthquake-resistant buildings since then," he said.

Tolou Kian describes his PhD research project, in a nutshell, as looking at high-performance reinforced concrete walls which have improved damage properties.

"Concrete walls are used in reinforced concrete structures to provide them with enough stiffness to withstand lateral forces," he said. "The goal of my project is to study the residual displacements of concrete walls that have fibre reinforcement and innovative steel reinforcements, to see if they suffer less damage from ground motion."

To replicate in the university laboratory what happens when concrete walls are shaken by ground motion, wall specimens were anchored to the laboratory floor, and then were hit with the same back-and-forth motion of an actual earthquake.

The response of the test walls was captured by sensors and a digital imaging system that measured the extent of the walls' deformation caused by the experimental ground motion.

The concrete walls used in the tests contained two types of fibres: PVA (Poly vinyl alcohol) fibres 12 mm long, and hooked-end steel fibres 50 mm long.

"In general, fibre reinforcement increases the resistance of concrete, because it limits the opening and propagation of cracks," said Tolou Kian. "In the study, fibre reinforcement mitigated concrete damage, including cover spalling (peeling and flaking, due to moisture in the concrete])and cracking, in the test walls."

Three types of advanced concrete reinforcement were used in the study: 1. Shape-memory alloy, an alloy of nickle and titanium; 2. glass-fibre reinforced polymer, a composite material made of glass-fibres held together by a polymeric binder, and 3. high-strength steel, about three times stronger than conventional steel.

"The distinctive property of these types of advanced reinforcement, compared to conventional steel, is their tendency to return to their original lengths after being unloaded (from ground motion)," said Tolou Kian. "This means that if you stretch them, they will return to their initial shape when released.

"This property of the advanced reinforcements helps reinforced concrete walls return to their original position after resisting an earthquake. They will suffer less damage, can be repaired sooner, and require less retrofit funding."

Tolou Kian's PhD is being supervised by Professor Carlos Cruz-Noguez, a specialist in masonry systems.

The experimental part of the study and preliminary numerical modeling of the sample walls was completed in 2017.

"The next step of the study, to begin this summer (2018) to numerically simulate the response of four full-scale reinforced concrete structures, with and without high-performance walls, under different ground motions, in order to measure the effectiveness of test innovations in the design and construction of reinforced concrete structures," said Tolou Kian.