ANALYZING ATLANTIC CANADA

Driveability assessments and PDA testing remain GEMTEC's core strengths

By Barb Feldman

GEMTEC was formed in 1986 in New Brunswick as a geotechnical engineering, materials testing and hydrogeology firm by three geotechnical engineers. Today, the Canadian-owned-and-operated consulting company has a combined team of more than 120 engineers, scientists, technical personnel and support staff, including one of its original founders, Daryl DeMerchant, who continues to work as a specialist consultant.

"GEMTEC stands for 'Ground Engineering and Materials TEChnology,'" said engineer Dave Purdue, GEMTEC's manager of geotechnical engineering. "We have particular expertise in driveability assessments and Pile Driving Analyzer (PDA) testing related to driven foundations."

The company has offices and laboratories in Fredericton, Moncton, Bathurst, Grand Falls and Saint John, New Brunswick. They specialize in site investigations, foundation design, pile driving analysis and inspection, slope stability assessments, excavation and earthworks, dams and retaining structures and have evaluated foundation conditions for commercial and industrial buildings, dams, pipelines, highway bridges, railways, power plants, industrial plants, mines and waste facilities. GEMTEC subsidiary Houle Chevrier Engineering Ltd., with offices in Montreal and Ottawa, provides specialist services in geotechnical engineering, materials testing and inspection, hydrogeology and environmental engineering.

GEMTEC has been involved in projects in the U.S., the Caribbean and the EU, but the majority of its work has been for the design of deep foundations throughout Atlantic Canada and from Newfoundland to NWT, says Purdue, who notes that most piling in Canada is driven, particularly in Eastern Canada.

"Driven piles are very well suited to changing bedrock profiles because of the ability to quickly splice piles to achieve the desired elevations," he said.

A quick, non-destructive way to estimate hammer efficiency, driving stresses, pile capacity and damage

GEMTEC has been providing PDA services to its clients for over a dozen years. The pile driving analyzer was developed about four decades ago to be a non-destructive and quick method of estimating pile capacity, hammer efficiency, driving stresses and pile damage. Over the years, the company has had an ongoing relationship with Pile Dynamics, Inc. of Cleveland, Ohio, one of the technology's earliest developers and manufacturers. GEMTEC's engineers regularly attend upgrading and training courses, provide feedback to the manufacturer and have helped the technology gain acceptance in Atlantic Canada.

"It's a great tool for the successful installation of piling and to prove the pile capacity in order to meet project specifications," said Purdue. "The use of the PDA has definitely increased under building codes and as specified by engineers."

And although the basic physical theories and science on which the PDA was first based remain the same, he says, the compactness, speed and efficiency of PDAs have been drastically improved over the past 40 years as computing technology, data storage and size have evolved. Because the equipment now essentially consists of proprietary software running on a laptop-style interface and some sensors and gauges, "it's a mobile business – you can pack it up in two or three boxes and put it on an airplane," he said.

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"Throughout North America, there's a call for infrastructure renewal. We see geotechnical engineering as a growing industry."

– Dave Purdue, Manager, Geotechnical Engineering, GEMTEC

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GEMTEC
Consulting Engineers and Scientists

Left: GEMTEC has provided PDA services to clients for over 12 years. Top right: Driven piles are prevalent in Eastern Canada as piles can be spliced to accommodate the changing bedrock profiles. Lower right: Preparing pile for PDA test at Canadian Tire Truro, Nova Scotia.

GEMTEC's experts are also adept in the use of geotechnical tools such as piezocone and seismic cone penetration testing equipment, piston samplers and plate load testing equipment and state-of-the-art modeling software programs such as GRLWEAP and SLOPE/W. The company has also developed its own customized laboratory software unique to the engineering field. Such tools are often key to helping its engineers provide solutions to difficult or complicated problems.

Sorting out solutions

Purdue describes a problem that arose during the Brun-Way project. The 60-mile, four-lane highway project twinned Highway 2 from Woodstock to Edmunston in New Brunswick, and included a number of bridge structures with very challenging geological conditions. Of the more than 40 structures, GEMTEC tested one that proved to be problematic – testing indicated that the steeply sloping bedrock surface under the Big Presque Isle Bridge had led to pile damage in the driven H-pile foundations.

When a sample of that pile was extracted, he said, "It was discovered that about the lower 12 feet (3.65 metres) of the piling was severely yielded," and so further piles were extracted. "It was up to GEMTEC to try to come up with a solution, to continue the foundation construction in such a manner that would eliminate the damage problem but satisfy the load-bearing requirement of the foundation. You certainly don't lightly recommend pulling piles out once they are installed," he added. "But when our equipment indicated there was pile damage and then physically obviously there was, although it was unfortunate that it happened, it gave us, the contractor and the owner much more confidence in this technology."

Since driving rock sockets or caissons would have required mobilizing expensive equipment and making significant design changes, with both major schedule and monetary implications, "We were able to use the PDA to more or less carry on with the existing methodology. We monitored each pile as it was installed into the foundation

Above: NB Coal 8200 Marion walking dragline viewed during rock fill placement. Top right: Coring concrete base on one of the seven piers for the new Petitcodiac River bridge, Moncton, New Brunswick. Lower right: Rock slope stability assessment, Fundy Parkway, New Brunswick.

with the PDA unit – typically you'd only do a sampling of them," said Purdue, which allowed all the piles to be driven to their capacity just prior to yielding. "We were able to drive a few more piles in this mass foundation to come up with the net total capacity requirement," and the few extra driven piles were not damaged. "We were able to get the project back on track and on schedule."

Geotechnical engineering: A growing industry

Seven years ago, GEMTEC identified another application for its geophysical department's expertise in the use of ground-penetrating radar, GPS/GIS, magnetometry and other specialized techniques: locating unexploded ordnance (UXO). For two seasons, one of GEMTEC UXO experts gained wide recognition as one of the stars of "Bomb Hunters," a reality-TV series on the History Channel that follows a cast of bomb clearance and disposal teams to former military training sites across Canada and the U.S.

But it's ground engineering and materials technology that GEMTEC is still best known for and remain its core strengths. In 2001, the company received an Award of Merit from the Association of Consulting Engineers of Canada for its role in using old landfill materials for earthwork construction in Miramichi City, New Brunswick. In 2003, GEMTEC was given the United States Environmental Protection Agency Phoenix Award for its involvement in what at the time was the largest brownfield redevelopment project in eastern Canada, the cleanup of the formerly contaminated CN Rail Car Shops in Moncton. And in 2012, Purdue accepted the national Engineers Canada Project of Achievement Award on behalf of GEMTEC for the innovative $65-million Port of Belledune expansion, for which he was designer and project manager.

"Throughout North America, there's a call for infrastructure renewal," said Purdue. "We see geotechnical engineering as a growing industry."