Do Not Destroy

The benefits of non-destructive pile testing

By Jim Chibolyko

It's something many professionals – from doctors to engineers – usually ask themselves at some point: How does one test something without actually cracking it open? Testing, depending on the type of test and what's being tested can be harmful.

For those in the construction industry, one of the options available for analyzing piles is what's known as non-destructive testing (NDT). NDT is used throughout the world, however, in Canada, it seems that the rate of acceptance of using NDT on piles has been slow, albeit growing.

"We just entered into dynamic testing (low-strain pile integrity testing and pile driving analyzer work) in the last year," said Gil Robinson, P.Eng. of AECOM's Winnipeg, Man. office. Low strain pile integrity testing, one type of NDT, is a quick and easy test that can be performed on concrete and timber piles to check for major defects and estimate pile length. "In our local market, it's usually used if a problem is encountered during pile installation or if foundations for an existing building need to be evaluated.

"Although it's not commonly used in Winnipeg, it is more popular in some areas of the country and the United States. Part of the problem in Canada is the lack of locally available firms to conduct the testing."

They don't have the equipment, yet. That's something that Pile Dynamics Inc. (PDI) of Cleveland, Ohio, is trying to change. It's the firm that manufactures much of the equipment for non-destructive pile testing. Bill Herman, of PDI, said it has been the world leader in the manufacturing of such devices for 35 years.

Herman said Canada is a bit slow on the NDT uptake. "Thirty or 40 countries around the world have embraced NDT more rapidly than Canada," said Herman. "For example, we sell more pile integrity testing and cross hole sonic logging devices in the United States, Dubai, India and China and many far smaller countries."

"The term (NDT) is most often used in the context of these integrity tests, but a test that evaluates the capacity of a founda-
tion by the high strain dynamic method is also a non-destructive test," said PDI's Gina Beim.

The most common forms of non-destructive testing of deep foundations is pulse echo testing or low strain integrity testing (they go by a variety of names); dynamic load testing (high strain dynamic testing), which is used to check capacity, and serves as an alternative to static load testing is technically a non-destructive test, but the term NDT is most often used in the context of the low strain dynamic test.

For the integrity tests, it is a matter of using the pile integrity tester in combination with an accelerometer and a simple or instrumented hand-held hammer. In its simplest form, one hits the top surface of the pile with the hammer. A stress wave is produced by the hammer impact. As the wave travels down the pile and reflects up, it is picked up by the accelerometer, which is connected to the pile integrity tester. The instrument then uses software to interpret the data, revealing major cracks and other major defects. Integrity tests are often used to test non-driven piles such as drilled shafts and auger cast-in-place piles; it is also used to test driven concrete piles, as well as timber piles. It is not suitable to test steel piles.

Crossole sonic logging (CSL) is another type of integrity test (also known as crossole acoustical testing. CSL may only be performed in cast in place concrete foundations. CSL requires more planning ahead, as well, the pilings have to be prepared in advance; hollow tubes are inserted into the piles ahead of time,
and filled with water. A transmitter and a receiver are inserted each on one of the water-filled tubes, and the transmitter emits a signal that travels through the concrete and is picked up by the receiver. The strength of the received signal, as well as the time it takes to reach the receiver, are used to assess the quality of the concrete between the pairs of tubes.

Dynamic load tests involve impact, but need an impact larger than just a ball pein hammer. The pile driver strikes the pile and the accelerometers and strain gauges attached to the pile generate data for analysis. Dynamic load testing provides information on stresses in the pile during driving, performance of the pile hammer, pile capacity and resistance distribution and more.

Beim said, there are several reasons firms choose to add the testing equipment to their arsenal.

“The advantages of dynamic load testing is that it’s a faster test, and it’s often less costly than a static load test,” said Beim. “After post-processing by signal-matching analysis (CAPWAP*), it gives you information about resistance distribution as well. It gives you more info, as well.

“By offering dynamic load tests, you can extend your service to a broader market. You can offer services more attractive to a wider audience. And, static load sometimes cannot be performed for various reasons on site.”

The speed of testing can also be considered a factor.

“With driven piles, if you are performing the dynamic load test, with the info you get, you sometimes have enough information that you can make quicker decisions. With some analysis you can establish a driven criterion that may allow you to stop driving sooner, saving pile length without compromising safety,” Beim said.

Recent economic fluctuations, specifically the weakening American dollar, have made the market for testing products better. With the better value, the American-made instruments became more attractive to the foreign markets.

“We have been seeing a lot of demand for the pile driving analyzer,” said Beim.

And while the purchase of testing equipment can still run several thousand dollars, “It probably pays off fairly quickly, either way,” said Beim. In terms of training, firms that purchase their equipment receive a one- to three-day (depending on the instrument) certified course to be able to use it properly.

“It depends on what kind of business you are in,” said Beim. “But if you are in the business of assuring quality, it is a good thing to have in your toolbox.”