The TIP is Tops

Faster results, complete coverage, ease of testing and information on cage alignment are just some of the advantages of the new Thermal Integrity Profiler

By Lisa Kopochinski

Living up to its sophisticated name, the Thermal Integrity Profiler (TIP) is embodying a new, temperature-based technology for concrete foundation integrity testing.

The latest development of Pile Dynamics, Inc. (PDI), in partnership with Foundation & Geotechnical Engineering (FGE), the TIP offers a unique approach in that it uses measurements of the heat generated by curing cement to evaluate

Gina Beim, P.E., a senior consulting engineer and marketing director with Pile Dynamics Inc., collects TIP data on a worksite

PHOTOS COURTESY OF PDI

The Thermal Integrity Profiler offers a unique approach in that it uses measurements of the heat generated by curing cement to evaluate the integrity of cast-in-place concrete foundations

the integrity of cast-in-place concrete foundations. (Regions that are colder than expected are indicative of necks or inclusions – a cross-sectional area smaller than intended for the shaft. Regions that are warmer than anticipated indicate bulges – an excess of concrete in a particular location.)

"The heat generated by curing concrete had never before been used to assess the quality and shape of cast-in-place concrete foundations," explained Gina Beim, P.E., a senior consulting engineer and marketing director with PDI. "Measurements may be taken by a probe inserted into access tubes pre-installed in the shaft or by Thermal Wire® cables attached to the reinforcing cage."

Joint venture

The TIP technology was first developed prior to 2004 at the University of South Florida when an initial patent was filed. Then, in 2009, a joint effort between PDI and FGE was formed to incorporate this technology into the TIP instrument. In 2011, the TIP was taken to market.

"PDI and FGE realized the potential of the technology and how much it would benefit the industry," said Beim. "The industry was lacking a test capable of evaluating the shape and quality of the entire foundation element without length and diameter challenges and without skipping the important region outside the reinforcement cage."

The TIP can test all the way to the bottom of the shaft, and the temperatures measured reflect what is happening along the entire cross section both inside and outside the reinforcement cage.

"You can evaluate the entire shaft, lengthwise and cross-section-wise," she explained. "In addition, the TIP reveals the alignment of the reinforcing cage and the concrete cover, which neither cross hole sonic logging (CSL) nor pulse echo testing – also known as pile integrity testing (PIT) – can do. The TIP can also be performed much sooner than CSL or PIT, since those two need a fully cured shaft. TIP tests *during* curing – within 12 to 48 hours of shaft installation. I'm not saying that pulse echo and CSL do not have value. Pulse echo does not require pre-planning and

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CSL has years of tradition and does a very good job in the part of the cross section that it tests (inside the reinforcing cage), but TIP gives something extra."

Engineers benefit

As for those who benefit most from the TIP, Beim says it is project owners and contractors. Since the TIP provides earlier testing results, construction can proceed sooner, which pleases everyone involved.

"Foundation engineers benefit from a fuller picture of the foundation shaft, which includes the area outside the reinforcement cage and the cage alignment. And the engineer performing the test benefits from increased productivity."

Mark Brotherton, a principal geotechnical engineer with Parkland Geotechnical Consulting, which has several offices in Northern and Central Alberta, is very pleased with the TIP system.

"We believe that the TIP technology provides the best representation of the shape of a bored cast-in-place caisson in the ground," he said.

During the preliminary work for the Eastern Alberta Transmission Line for ATCO Electric, a detailed static load test program was undertaken on a number of driven steel piles and cast-in-place concrete caissons. PIT was proposed for production pile quality control testing to determine possible variations in the concrete shaft.

"As part of the load test program, a couple of secondary methods were requested for confirmation of the shape of the caisson shaft as a means of checking the PIT results," he explained. "One of these secondary methods was CSL and the other was TIP testing. We chose the TIP method over CSL because we felt that while CSL testing was well suited for detecting necking and inclusions in a concrete shaft, it had limitations in detecting bulges."

Brotherton adds that Parkland also chose to use the TIP model for embedded thermal wires over the probe version.

"The placement of embedded thermal wires into the reinforcing steel cage of a caisson was very easy and cost effective when compared to the tubes for CSL and the probe version of TIP," said Brotherton. "The use of the thermal wires also made monitoring much easier than the manual methods required when using the probe version."

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Not for driven piles

Beim does point out that while the TIP is beneficial for many applications, it is not for driven piles.

"It is for cast-in-place concrete foundations such as drilled shafts, bored piles, augered cast-in-place, continuous flight auger piles and drilled displacement piles. The technology may also be used to evaluate the shape of jet grouting columns and diaphragm or slurry walls, or other concrete structures. It is just starting to be used to investigate soil nails and micropiles, too, and feedback has been positive."

Added Brotherton, "We would recommend the TIP system. It should be recognized that the use of the TIP requires planning since the thermal wires or probe tubes need to be placed in advance of the concrete with the steel reinforcement. Therefore, large-scale use of the TIP in foundation construction is probably unrealistic. However, the selective use of the technology in identified special cases such as critical foundation installations in poor soil conditions has a lot of merit; and the use of TIP testing in conjunction with the large-scale quality control testing programs involving systems such as PIT would be very practical."

Cost and availability

Costs for the TIP varies depending on the configuration of the system, but a safe estimate for the initial system is on the upper end of $30,000. Customers can also rent the TIP. The system is rising in popularity in the U.S. and Beim says interest from Canada is also gaining momentum.

"The PDI sales team feels that this equipment will become popular in Canada as well as in the rest of the world in the upcoming year."

PDI does not yet have an independent sales representative in Canada, so sales are handled by the Cleveland-based sales team, where the company is headquartered.