

Thermal Integrity Profiler (TIP)

Assesses the quality of cast in place concrete foundations

The Thermal Integrity Profiler (TIP) uses the heat generated by curing cement (hydration energy) to assess the quality of cast in place concrete foundations such as drilled shafts, bored, augered cast-in-place (ACIP), continuous flight auger (CFA) and drilled displacement piles.

TIP results in brief:

| Regions that are | Indicate |
|--------------------|---------------------|
| Colder than normal | Necks or Inclusions |
| Warmer than normal | Bulges |

The expected temperature at any location is dependent on the shaft diameter, mix design, time of measurement and distance to the center of the shaft.

TIP measurements may be used to pinpoint areas of concern, estimate the actual shape of the shaft, and determine the concrete cover.

The Thermal Integrity Profiler evaluates the concrete quality of the entire cross-section, including outside the reinforcing cage, and along the entire length, without maximum length limitations.

Data Collection

TIP data is collected by either the Probe or the Thermal Wire™ System:

The TIP Probe Systemⁱ includes a thermal probe with four orthogonal infrared sensors and a Thermal Acquisition Port (TAPP). Data is collected by inserting the probe in standard (40 to 50 mm) plastic or steel access tubes (TIP results are



Thermal Integrity Profiler (Probe System).



insensitive to tube de-bonding; access tubes must be empty of water during testing) previously built into the shaft. The probe is lowered into the tube (a depth measurement unit registers its location) and measures the internal temperature which is recorded by the TAPP. For a given shaft diameter and field conditions it is possible to determine in advance the ideal time for the test - typically within 12 to 48 hours of casting. TIP displays temperatures versus depth in real time during the test.

The TIP Thermal Wire Systemⁱⁱ includes cables fitted with thermal sensors spaced at every 305 mm and a Thermal Acquisition Port (TAP). The Thermal Wires are attached to the reinforcing cage prior to concreting. The TAP automatically samples data from each embedded Thermal Wire at user selected time intervals, typically 15 minutes. Temperatures obtained throughout the concrete curing process are saved in the TAP, and may be collected at any time after casting. Data analysis is performed on measurements obtained near the time of peak temperature. A single Thermal Wire is attached to a center rebar for small diameter augered cast-in-place or continuous flight auger piles.

ⁱ Mullins, A. G. and Kranc, S. C., (2004), "Method for Testing the Integrity of Concrete Shafts," US Patent 6,783,273

ⁱⁱ Cotton, D., Ference, M., Piscsalko, G., and Rausche, F., (2010) "Pile Sensing Device and Method of Making and Using the Same" Patent Pending



Thermal Wire™ attached to rebar cage (shown adjacent to access tubes.)

Specifications

Thermal Integrity Profiler Main Unit

Physical Size: 135 X 104 X 52 mm
Weight: 0.45 Kg

Sunlight readable VGA color display for any lighting conditions,
resolution 640 x 480 pixels
Screen size: 9.4 cm
Temperature Range: 0 to 40° C operating;
-20 to 65° C storage
Powered by Internal Battery (8 hours duration)

Electronic Microprocessor: PXA270 @ 520 MHz
Data Storage: Built in 1 GB drive
USB port for easy data retrieval
Temperature Range: 0 to 40° C operating;
-20 to 65° C storage

Thermal Acquisition Port for Probes (TAPP)

Size: 133 X 114 X 57 mm
Weight: 822 g
Temperature Range: -20 to 65° C operating; -40 to 85° C storage
Internal Battery (8 hour duration)

Probe

Size: 127 x 30 mm (5 x 1.25 in)
Weight: 5.2 kg
Cable length: 60 m (200 ft)
Fitted with four orthogonal infrared sensors
Sensor operating temperature: up to 105° C

Depth Measurement Unit

Type: Rotary Encoder on a self retracting reel
Resolution: 2.5 mm

Thermal Acquisition Port for Wires (TAP)

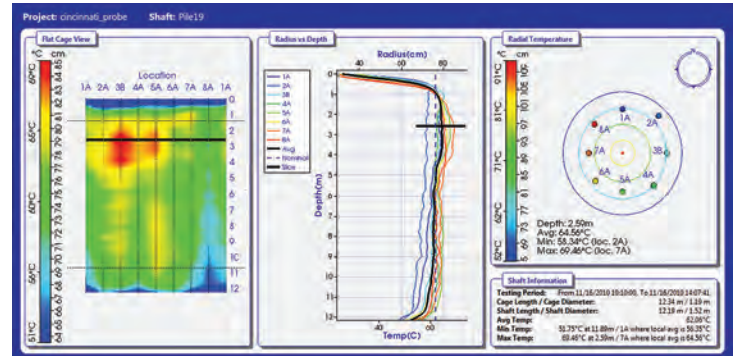
Size: 133 X 102 X 57 mm
Weight: 766 g
Temperature Range: -20 to 65° C operating; -40 to 85° C storage
Internal Battery (30 day duration)

Thermal Wires™

Furnished in rolls of length: 6 to 91 m (20 to 300 ft).
Other lengths upon request.
Sensor spacing: 305 mm (12 in)
Sensor type: digital
Sensor operating temperature: up to 105° C

Other

Full one-year warranty
Operates in English or Metric units
Technical manual included



Software

The TIP Reporter Software displays measured temperatures versus depth and mapped on cross sections of the shaft. This helps identify areas of concern such as potential over-pour bulges, necking, or cage alignment irregularities.

TIP Reporter also quantifies the concrete cover along the entire length of the shaft. In addition to TIP temperature measurements, this analysis requires the total concrete volume as an additional input. The shaft actual radius, reinforcement cage location and the concrete cover of the reinforcement bars can then be determined. The precision of this analysis improves when the temperature gradient (variation of temperature along radius at a certain elevation) is calculated given the measurements from the four orthogonal probe sensors or by additional Thermal Wires attached to the reinforcement cage.



Thermal Acquisition Ports for Thermal Wires (left) and for Probes (right)

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