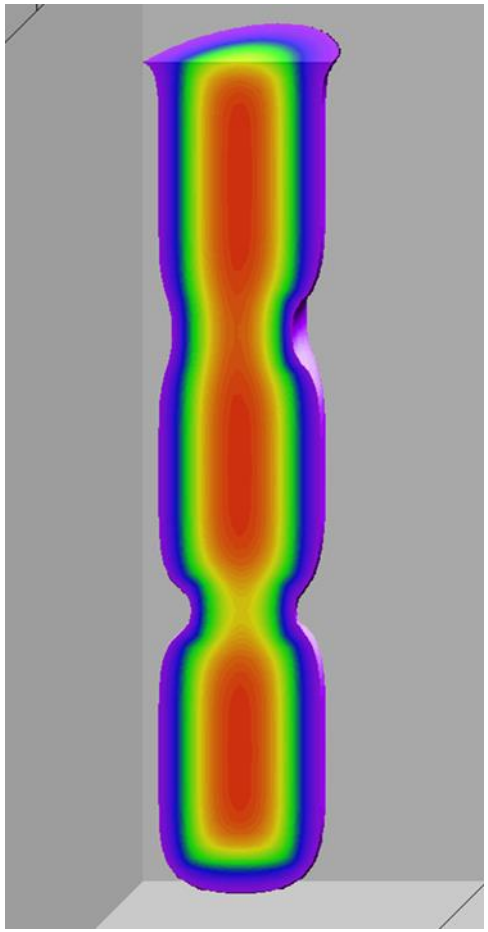
Optimizing the Use of Thermal Integrity System for Evaluating Auger-Cast Piles



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Civil & Environmental Engineering

Problem Statement

- Thermal Integrity Profiling (TIP) has proven to be an effective method for evaluating the as-built integrity of drilled shafts.
- However, TIP is rarely used for evaluating auger-cast-in-place (ACIP) piles, as current practices do not require installation of standard integrity access tubes.
- Current integrity methods for ACIP piles is limited, thus their FDOT use has been limited to foundations for sound walls.
- GOAL: Translate the use of thermal integrity technology to an effective method for evaluating ACIP piles.

Research Approach

- Task 1 Literature Review
- Task 2 Numerical Modeling
- Task 3 Feasibility Study of Probe-based Inclination Measurements
- Task 4 Field Testing
- Task 5 Reporting

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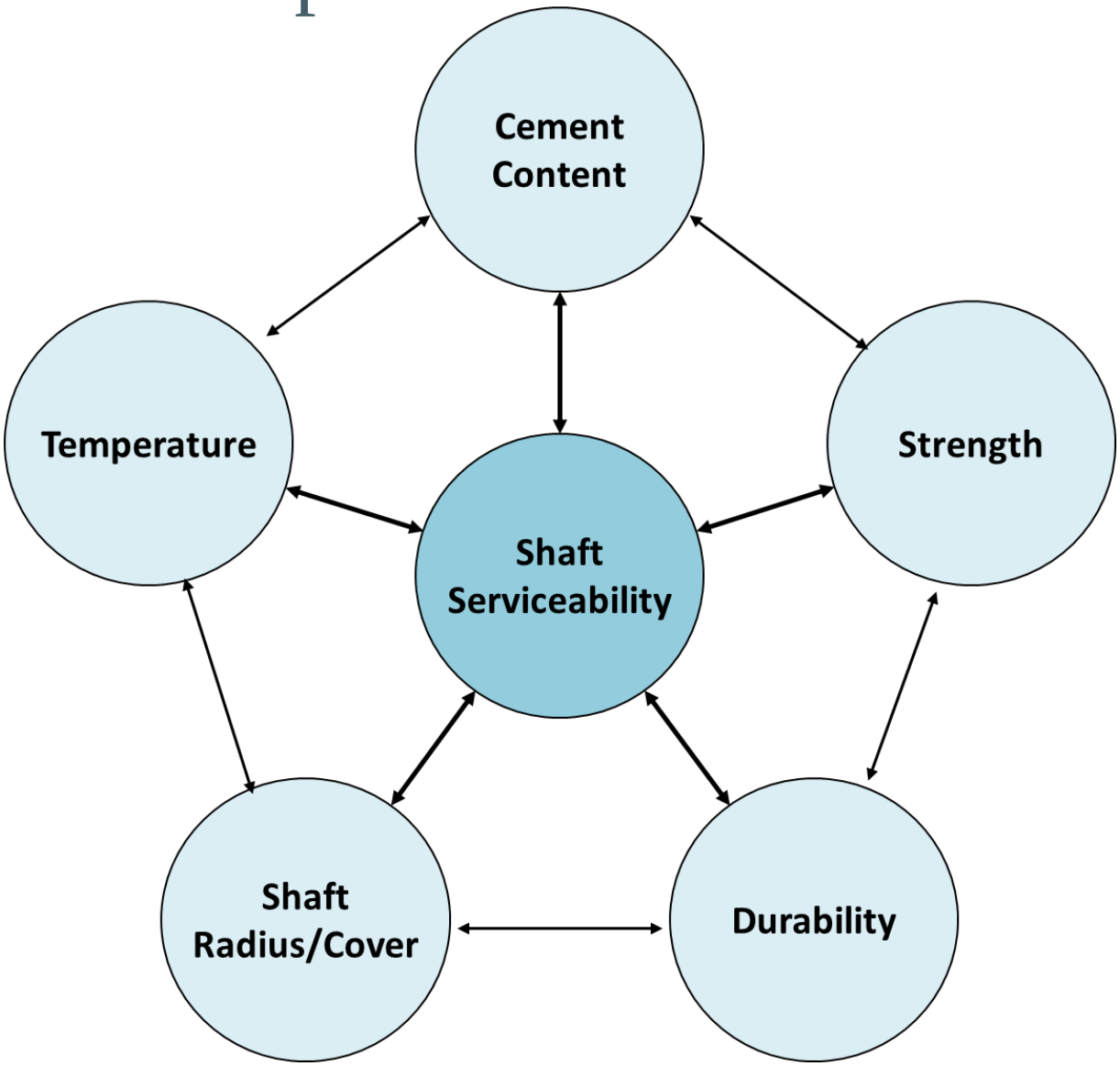
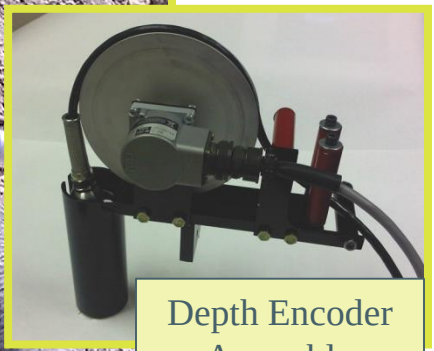
TIP Principles



TIP Methods
Infrared Probe

Thermal Probe w/ Infrared Sensors



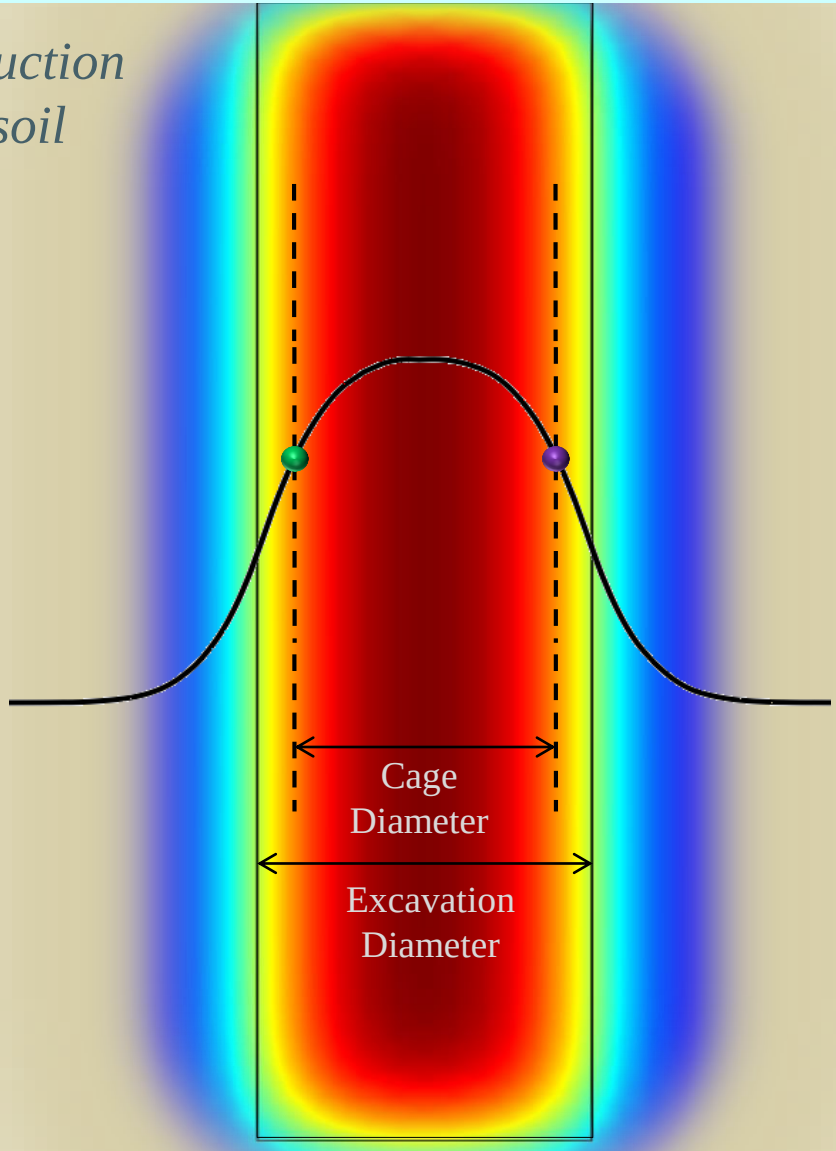
Depth Encoder Assembly

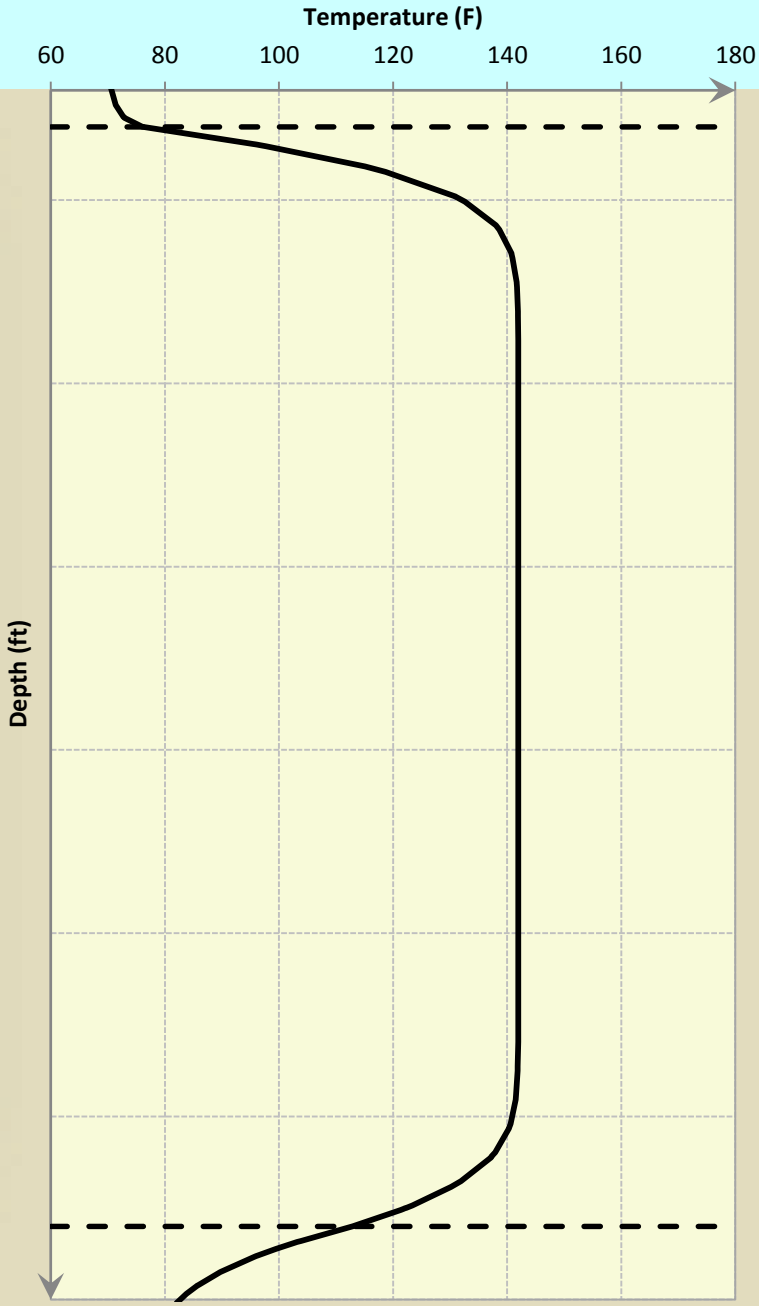
Data Collection System

TIP Methods
Thermocouple Wire

Convection to air

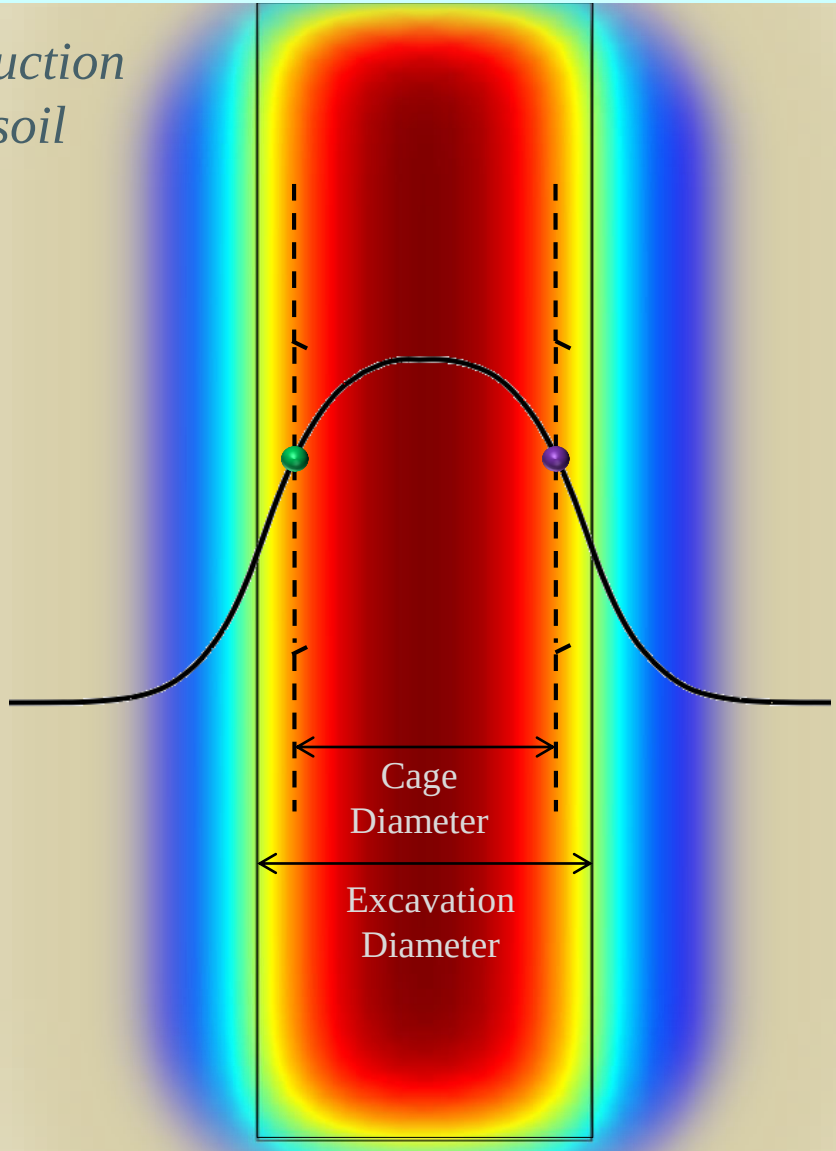
Conduction to soil

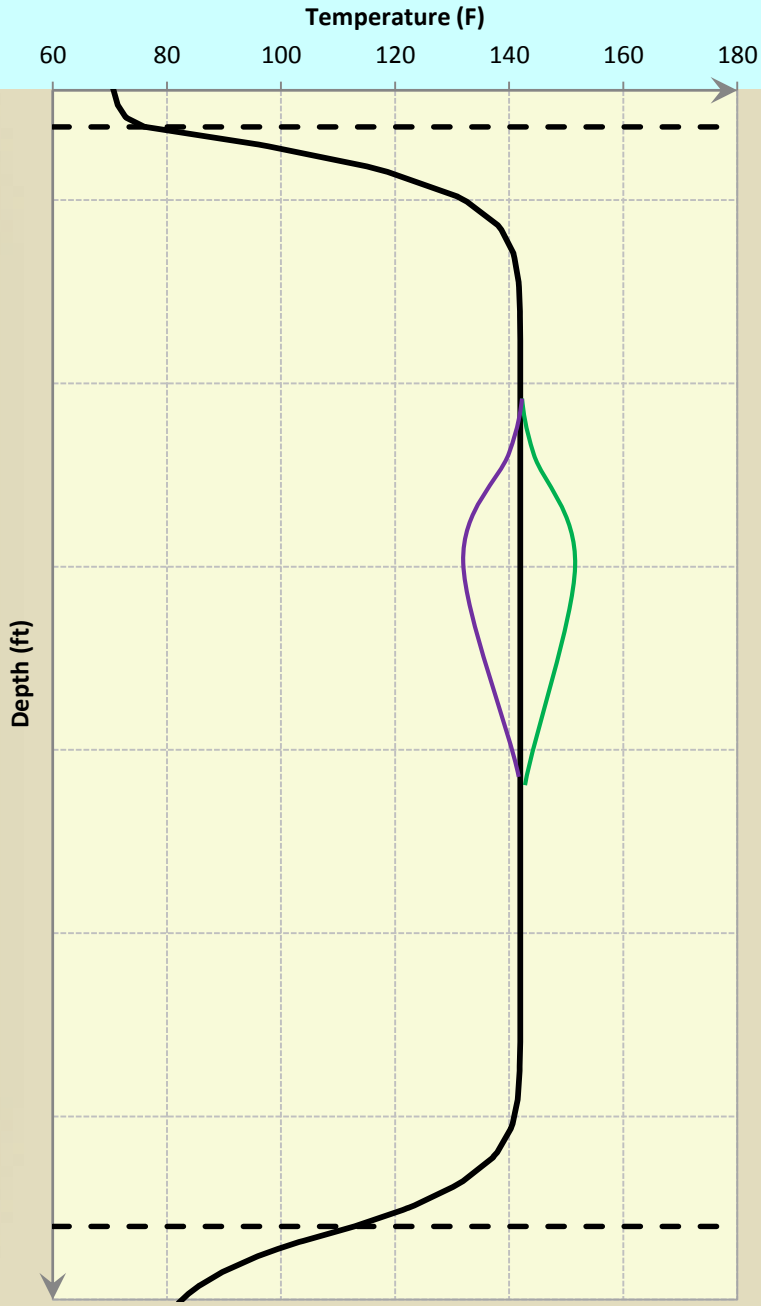


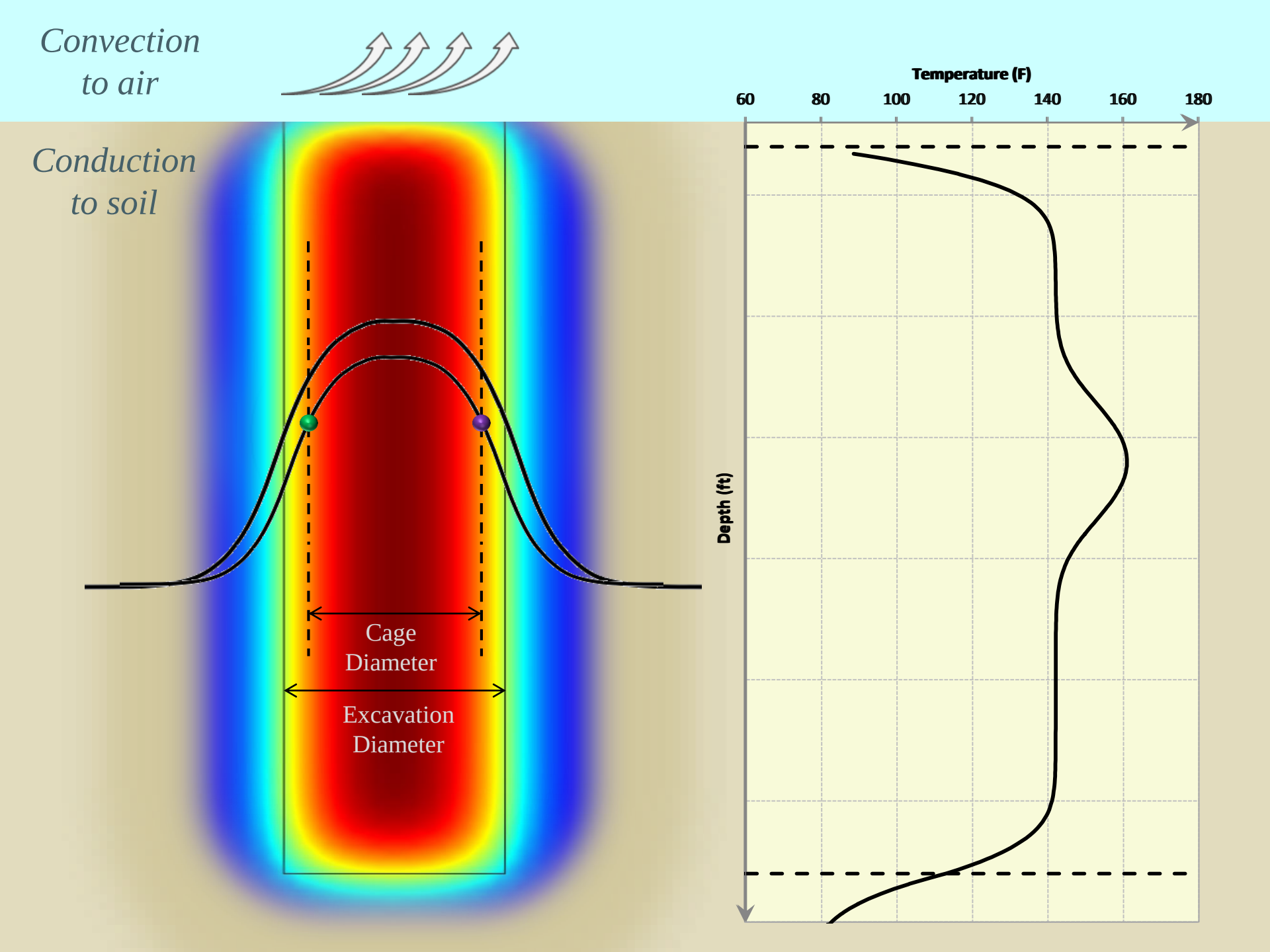


Convection to air

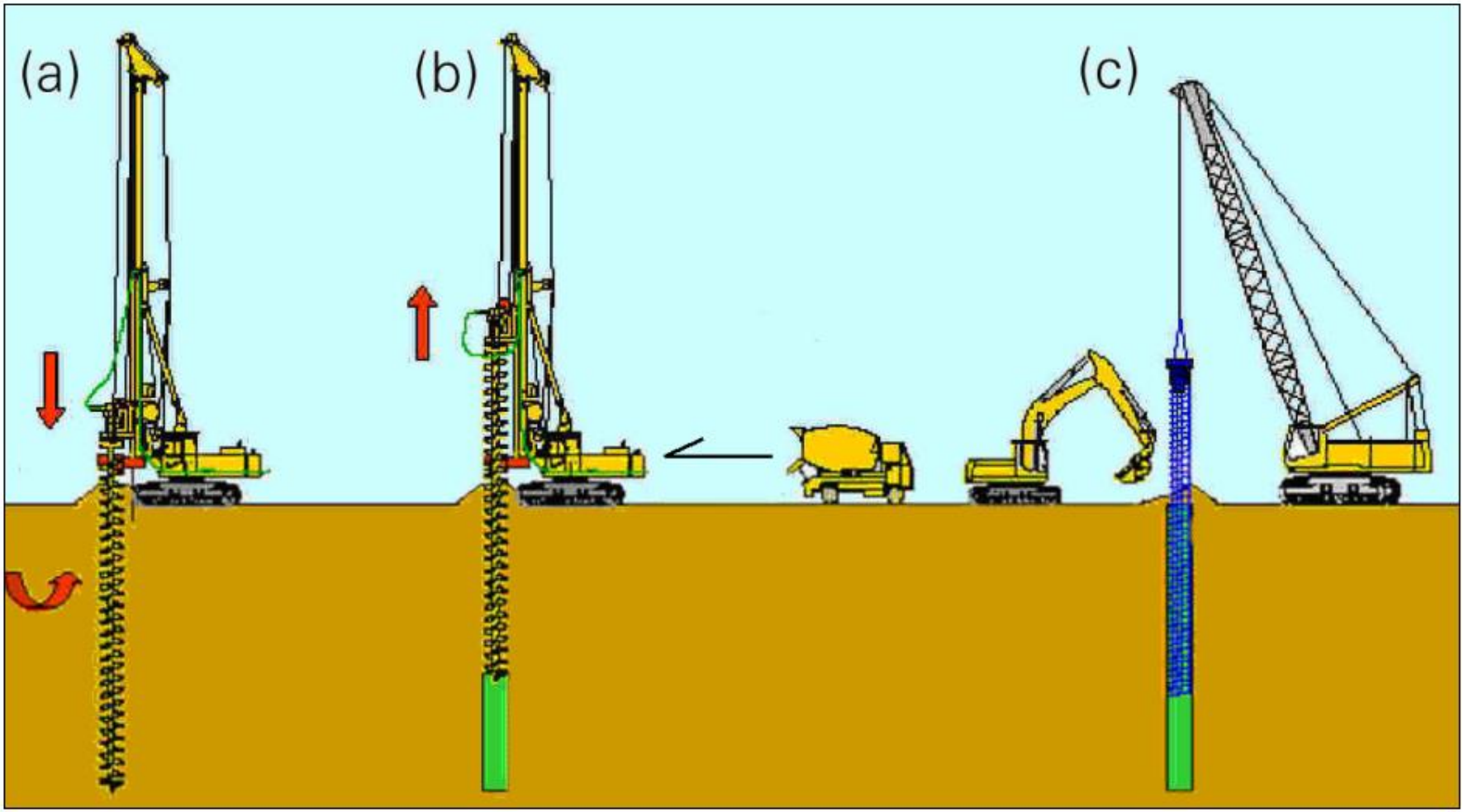
Conduction to soil






Convection
to air
Conduction
to soil
Cage
Diameter
Excavation
Diameter
Temperature (F)
60
80
100
120
140
160
180
Depth (ft)

ACIP Piles
Construction



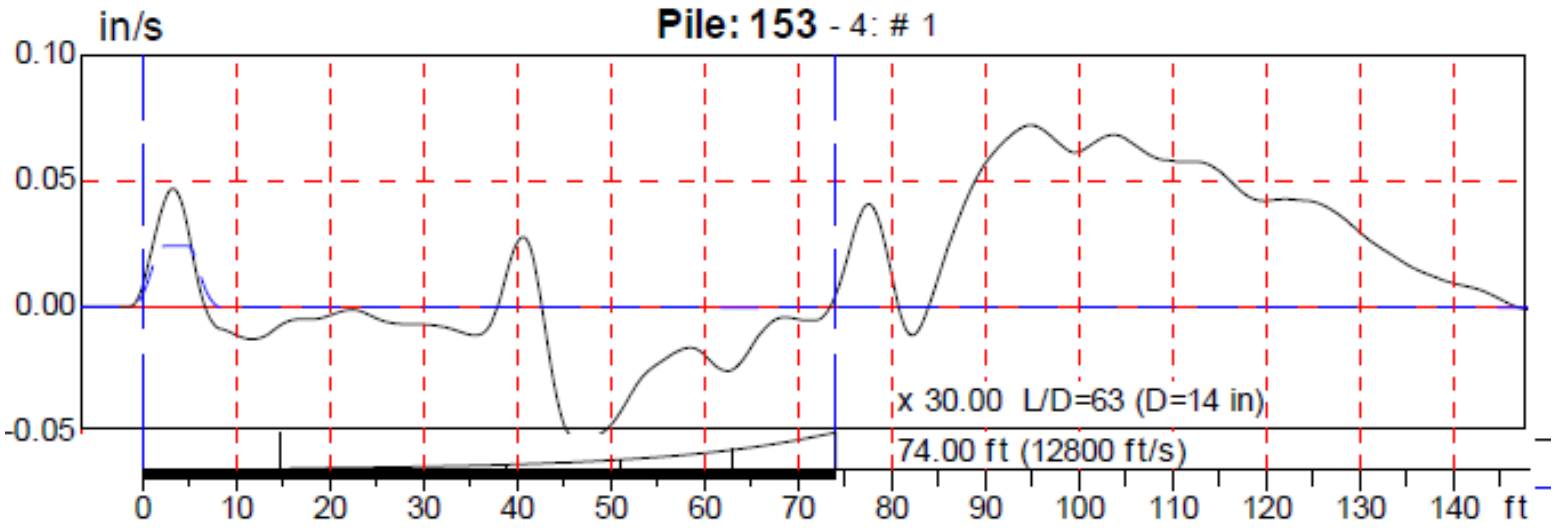
Source: Dan Brown et al., FHWA-HIF-07-03

ACIP Piles
Construction

ACIP Piles
Quality Control

ACIP Piles
Quality Assurance

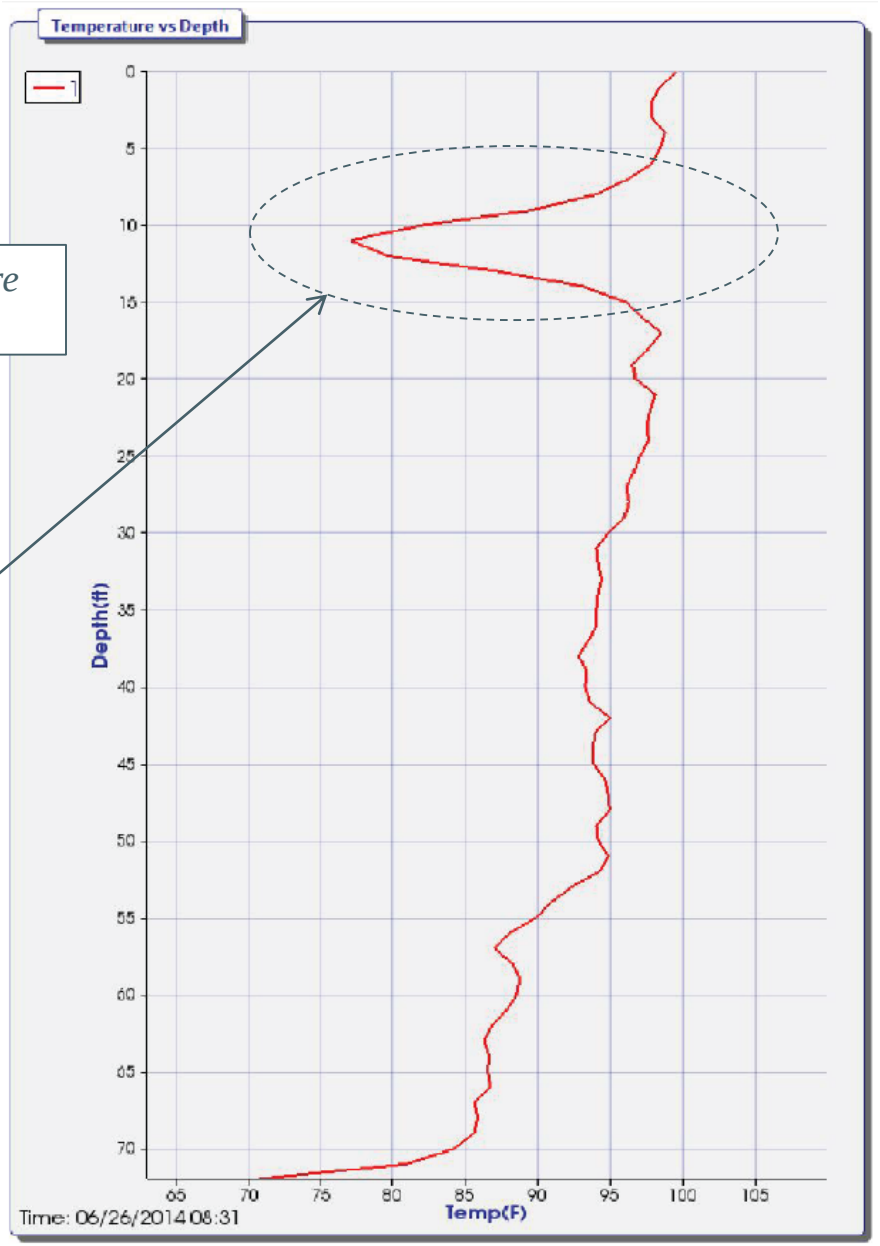
Surface methods involving stress wave propagation analysis are the most common form of integrity testing for ACIP piles.



ACIP Piles
Quality Assurance

Single thermal wire tied to center bar

Even with only a minimal set of temperature measurements, anomalies can be easily detected by direct observation of thermal profiles.



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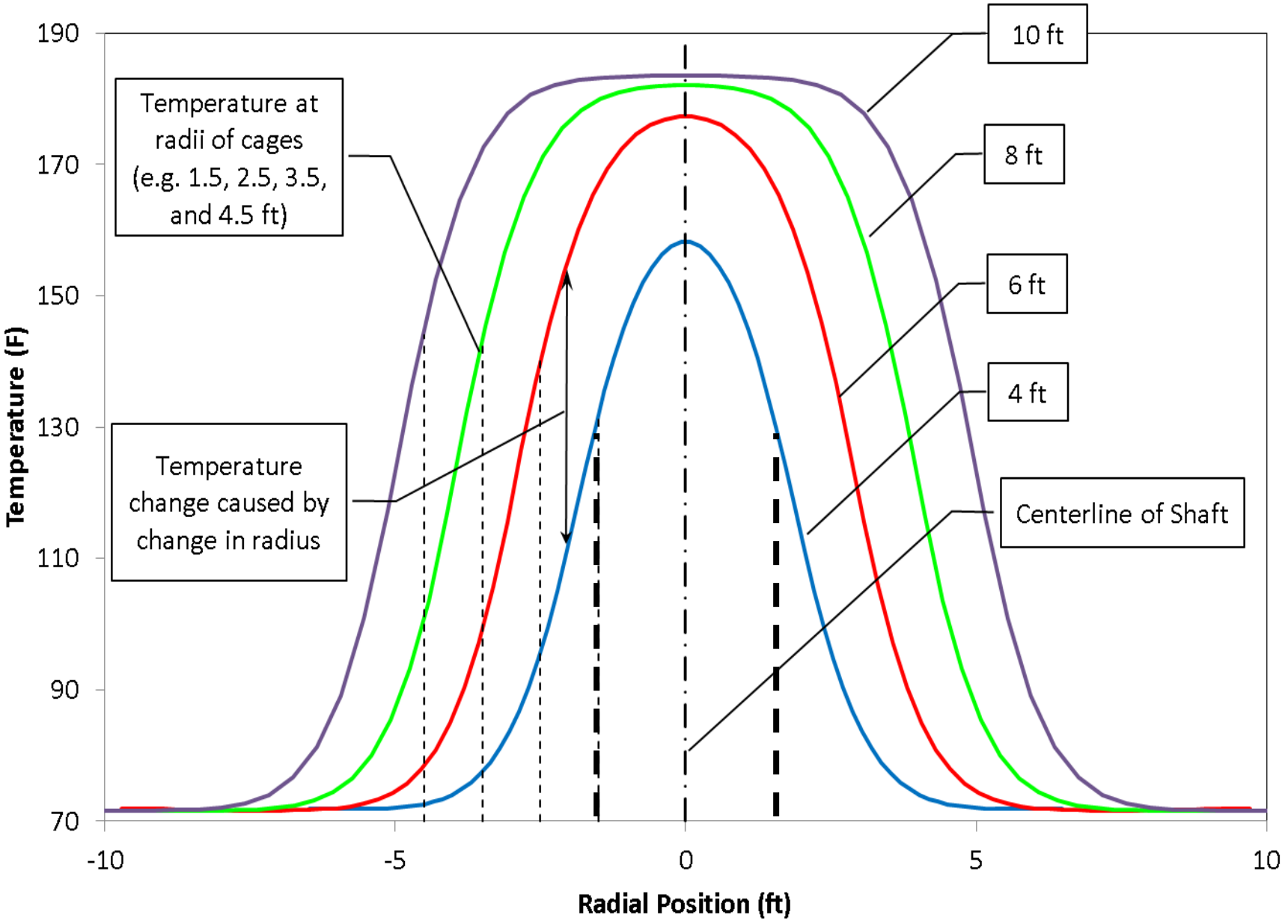
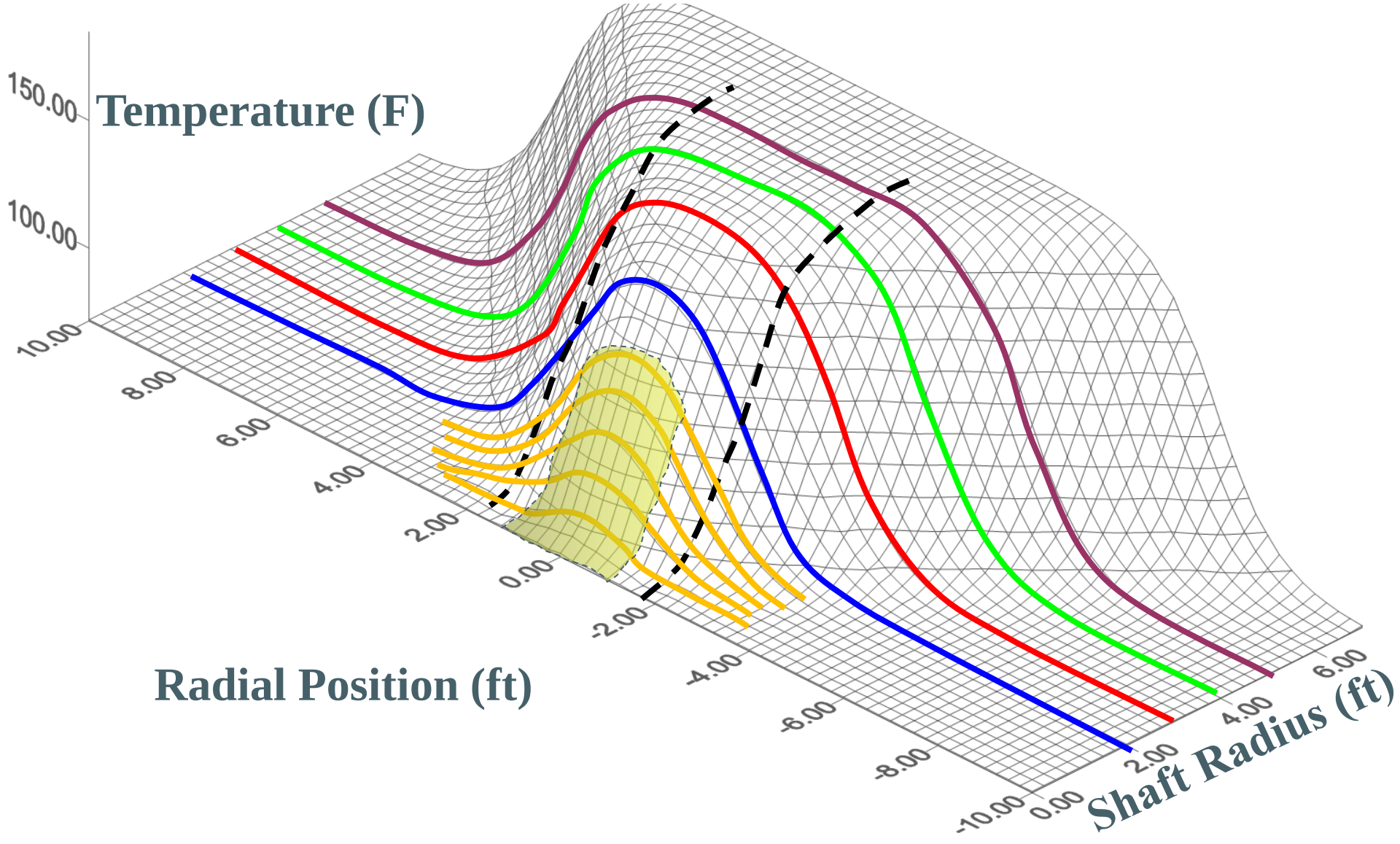
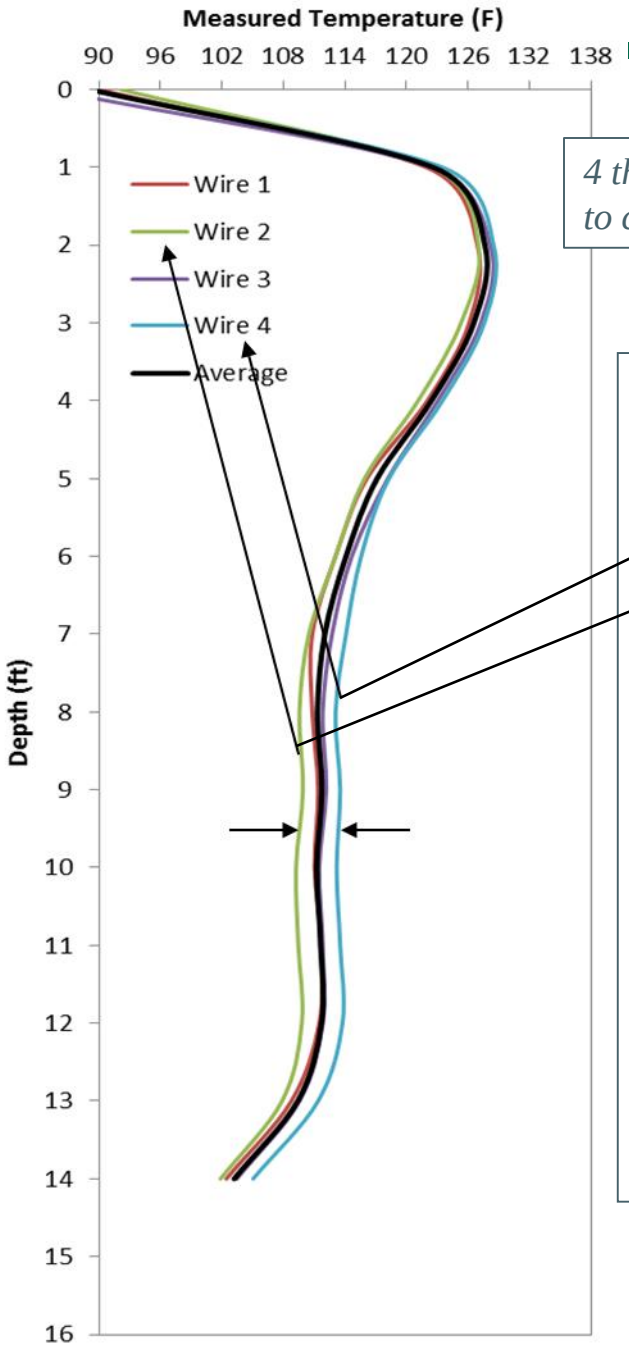
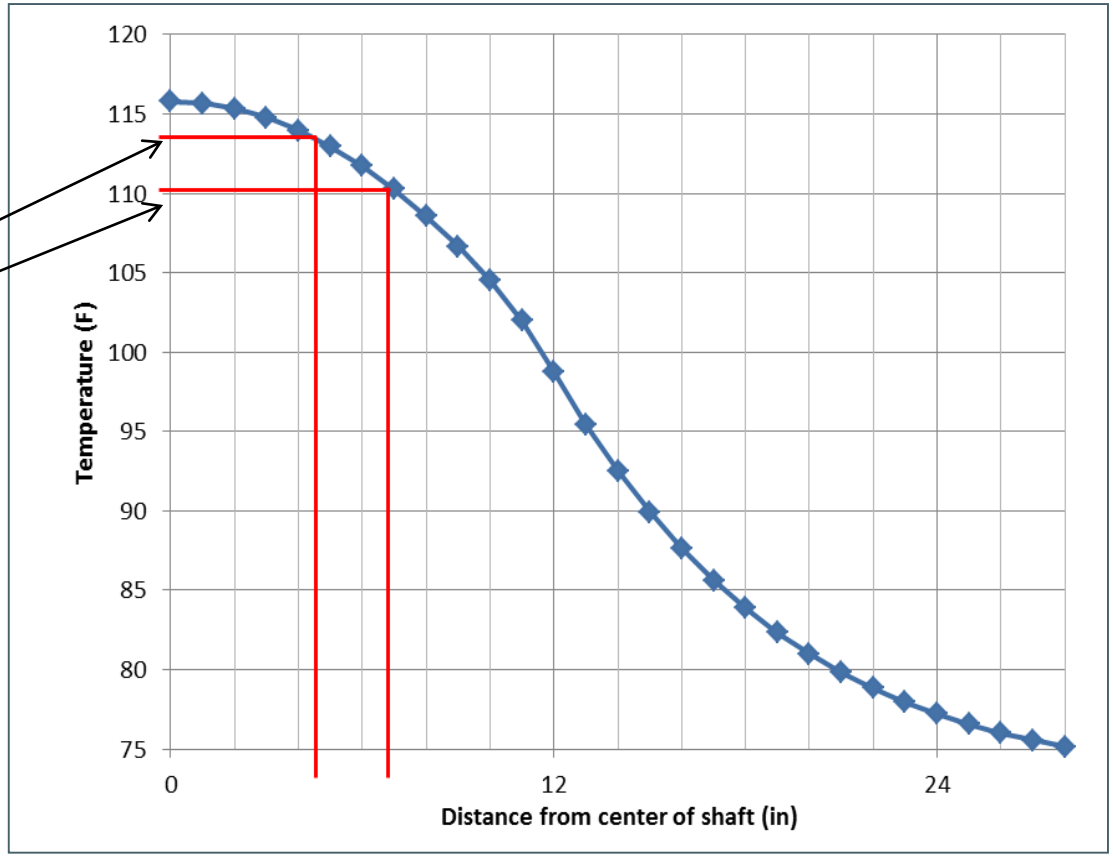

190
170
150
130
110
90
70
Temperature (F)
-10
-5
0
5
10
Radial Position (ft)
10 ft
8 ft
6 ft
4 ft
Centerline of Shaft
Temperature at radii of cages (e.g. 1.5, 2.5, 3.5, and 4.5 ft)
Temperature change caused by change in radius

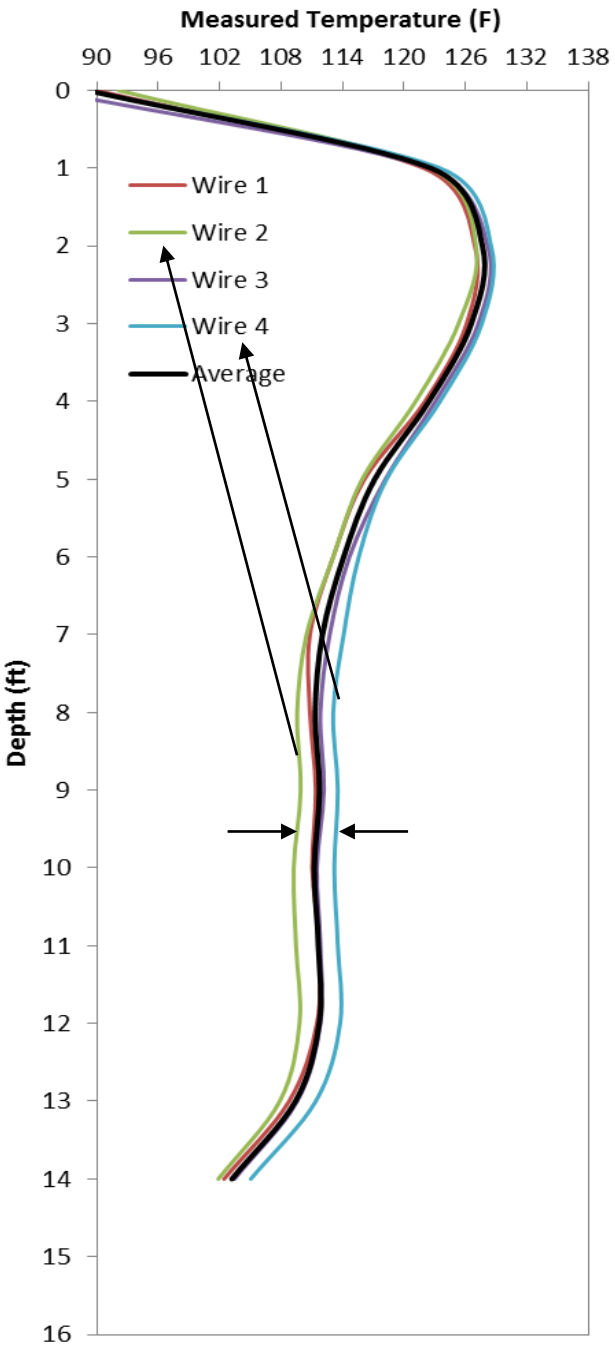
Effects of Alignment and Shaft Radius

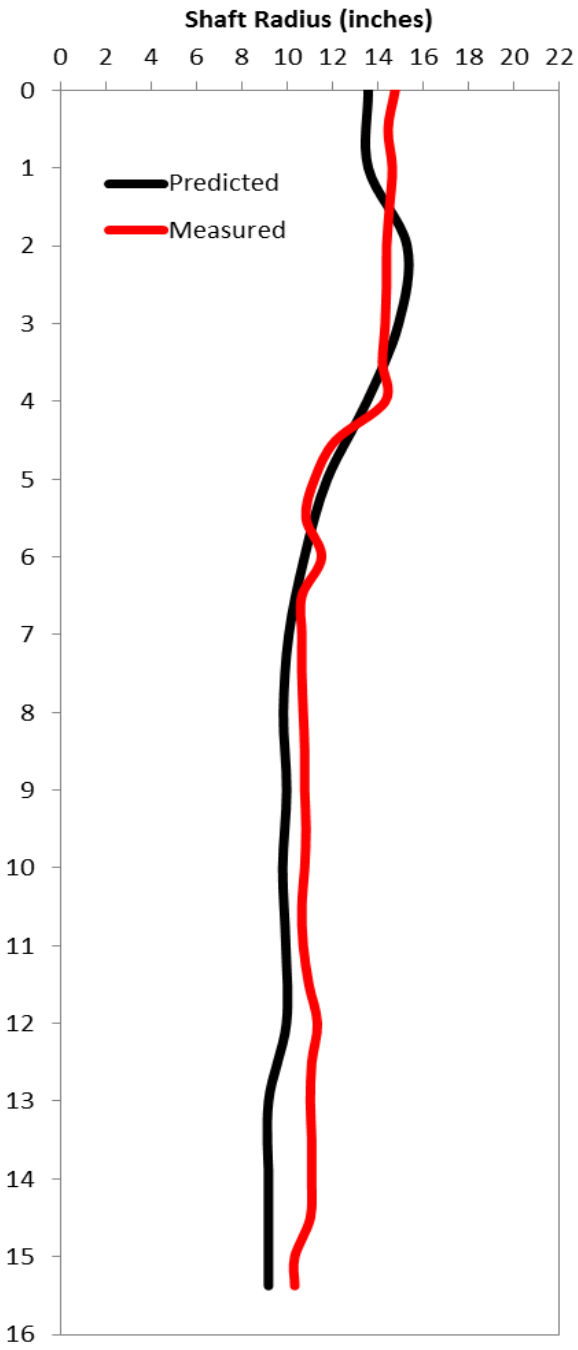




4 thermal wires tied to center bar







Signal matching approach yields good results but can be time consuming for everyday practice.

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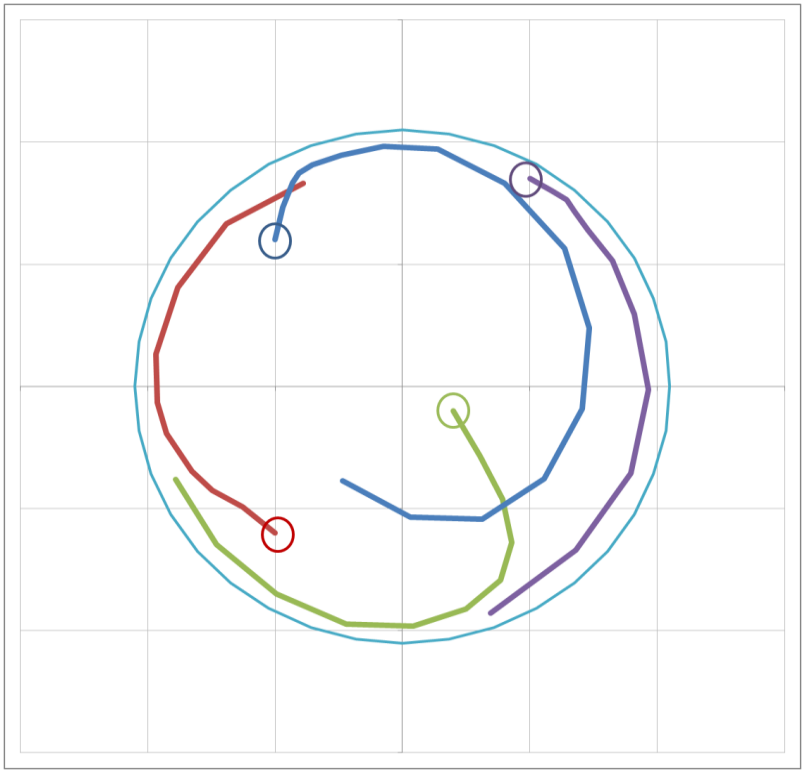
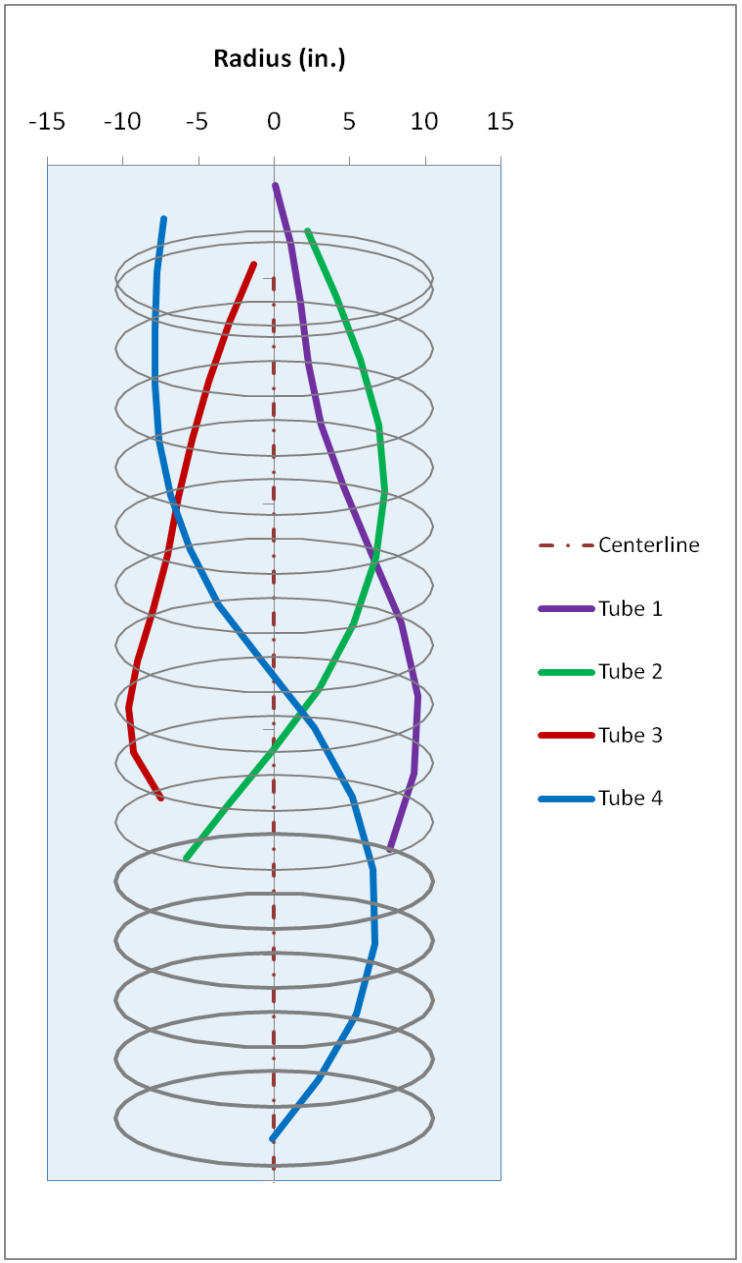
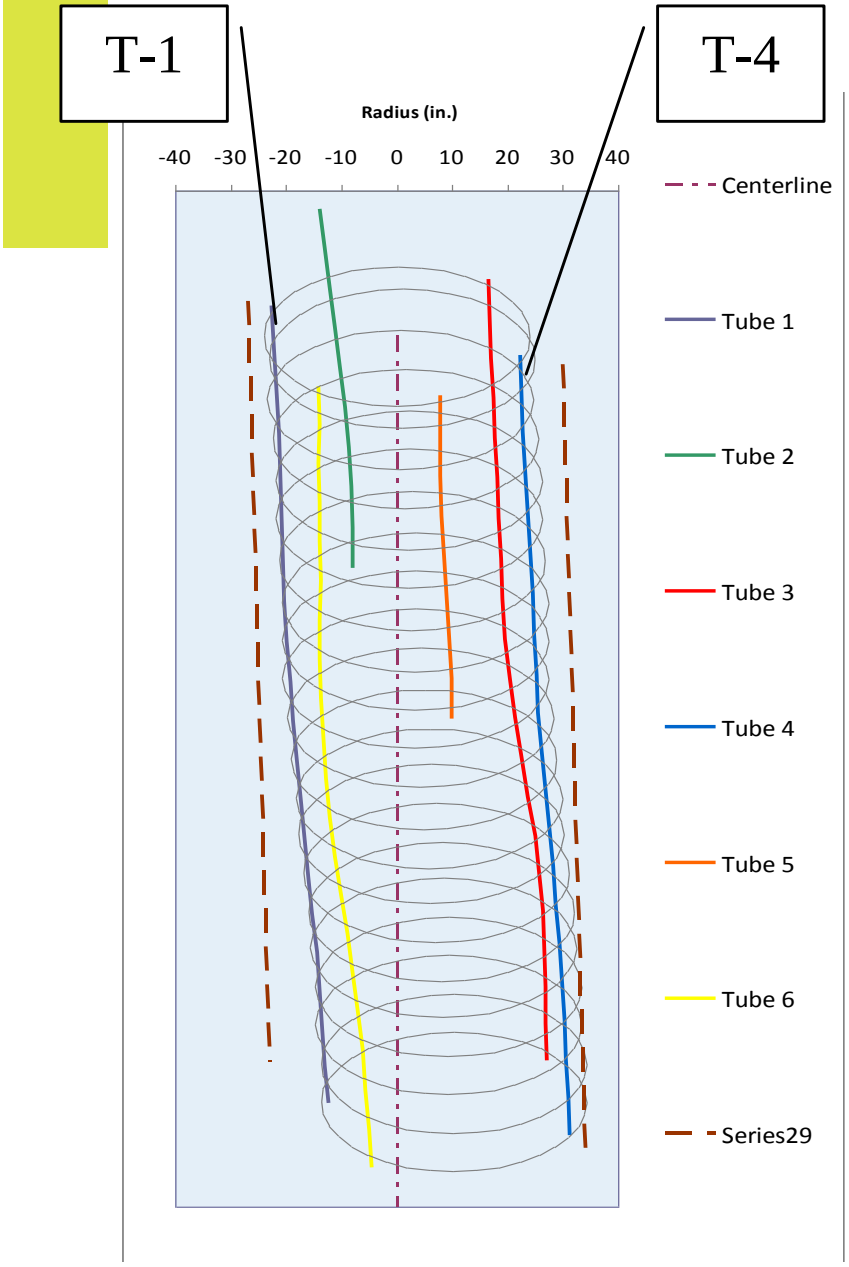
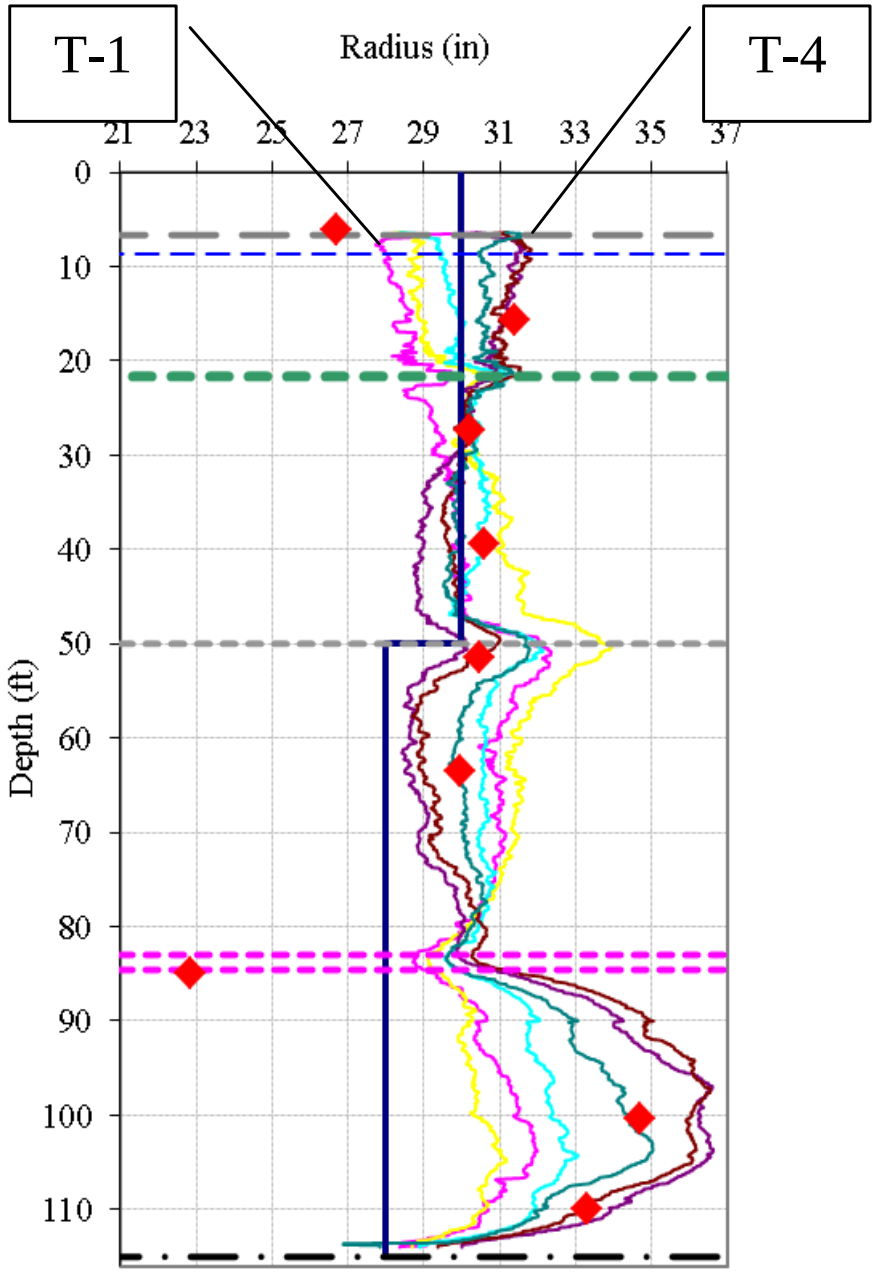
Inclination Measurements

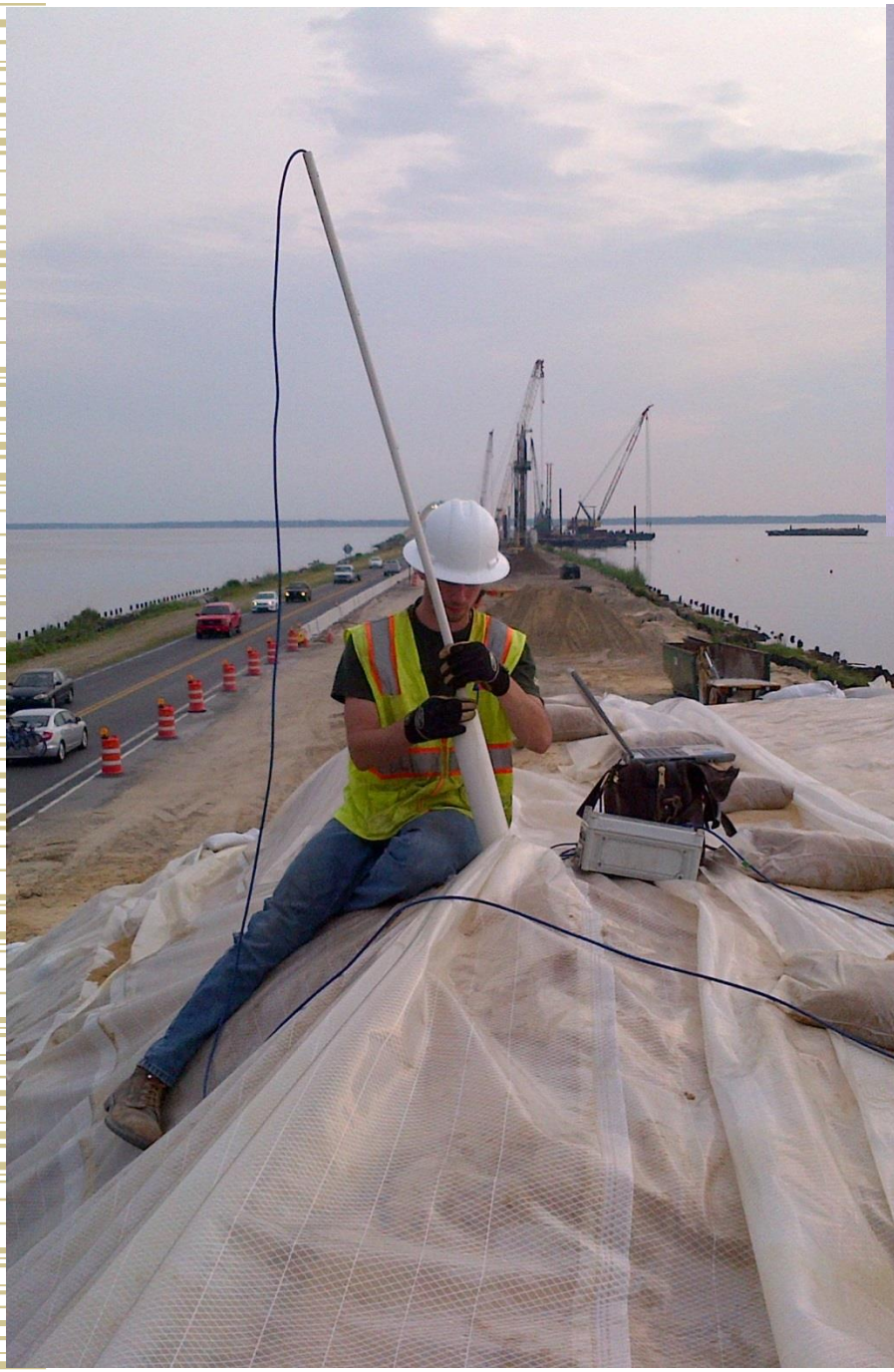
Inclination Measurements

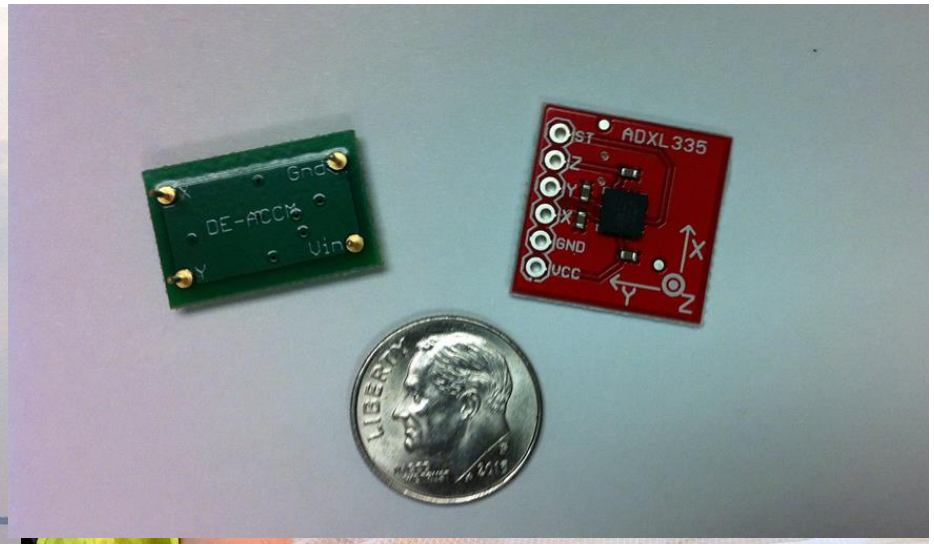


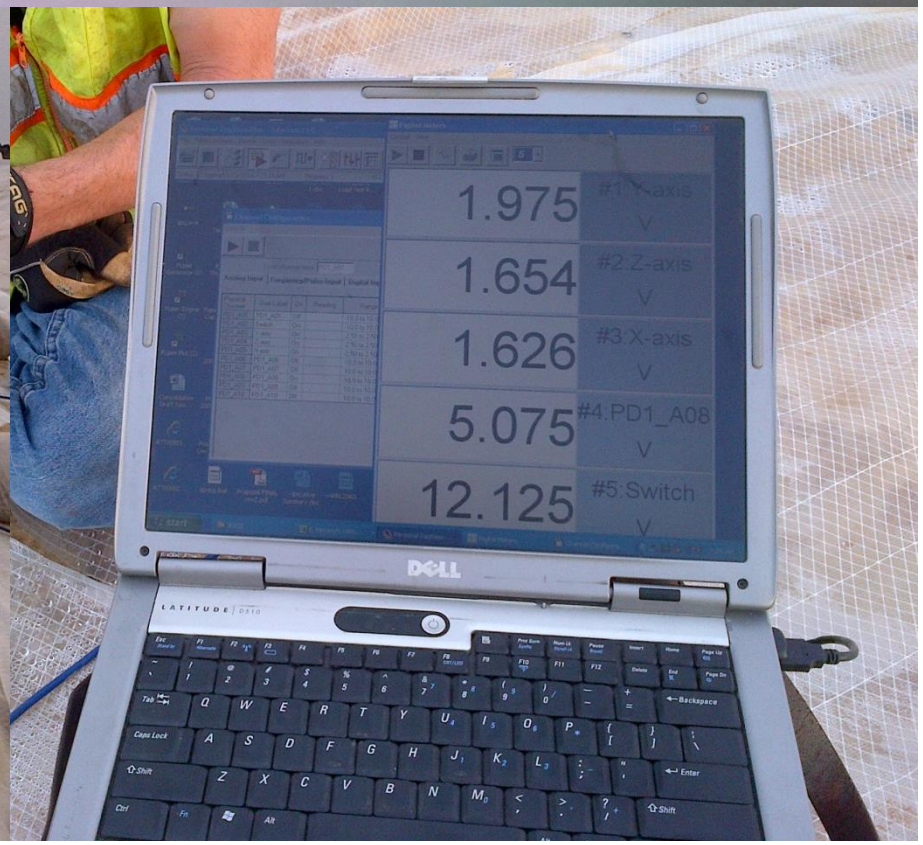



T-1
T-4
Radius (in.)
-40 -30 -20 -10 0 10 20 30 40
Centerline
Tube 1
Tube 2
Tube 3
Tube 4
Tube 5
Tube 6
Series29


T-1
T-4
Radius (in)
21 23 25 27 29 31 33 35 37
Depth (ft)
0 10 20 30 40 50 60 70 80 90 100 110




ADXL335
ST
Z
Y
X
GND
VCC
Vin
LIBERTY


1.975
#1:X-axis
V
1.654
#2:Z-axis
V
1.626
#3:X-axis
V
5.075
#4:PD1_A08
V
12.125
#5:Switch
V
DELL
LATITUDE

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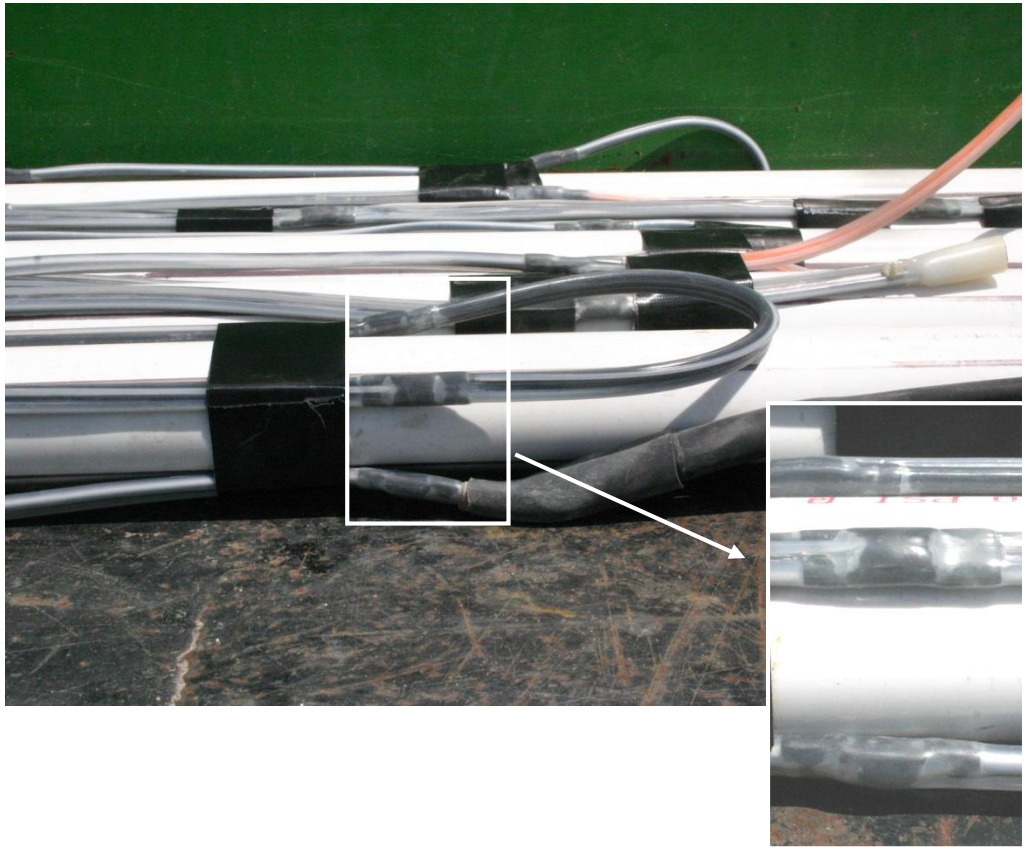


TAP

Questions?


TAPP

Thermal Integrity Profiler
UP
DOWN
CLOSE
Pile Dynamics, Inc.