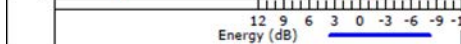
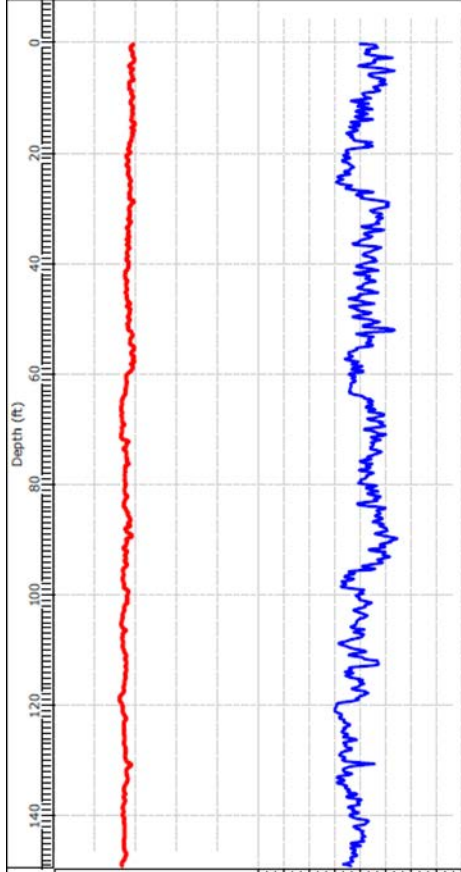




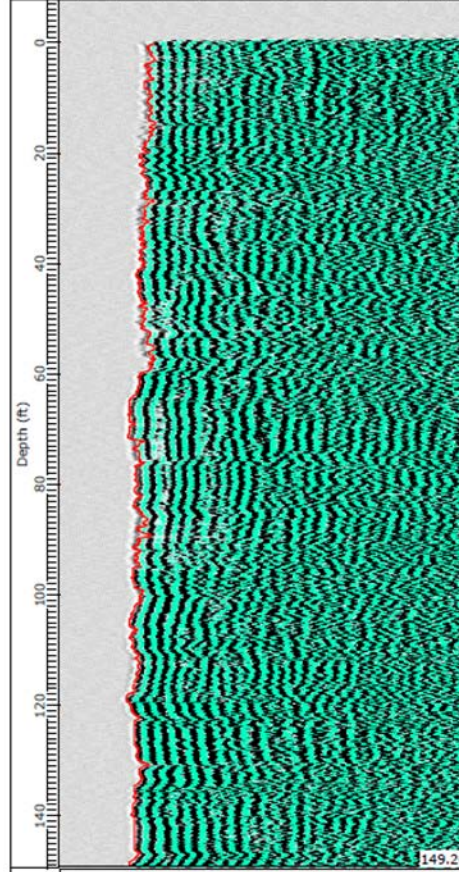
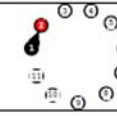
CSL

T Terracon Consultants, Inc.
CANEY FORK RIVER BRIDGE

SHAFT 1 BENT 2
Tube Number=1-2 (F3,3)
L=157.01,157.12 ft
Spacing=30.8 in
Gain=395
11/12/2013 09:03



SHAFT 1 BENT 2
Tube Number=1-2
L=157.01,157.12 ft
Spacing=30.8 in
Gain=395 (x8)
11/12/2013 09:03



CSL



West Tower Drilled Shaft Foundations
Arthur Ravenel Jr. Bridge, Charleston SC

PROVIDES:

- Integrity Evaluation
 - Along entire Shaft length
 - Size & location of anomalies

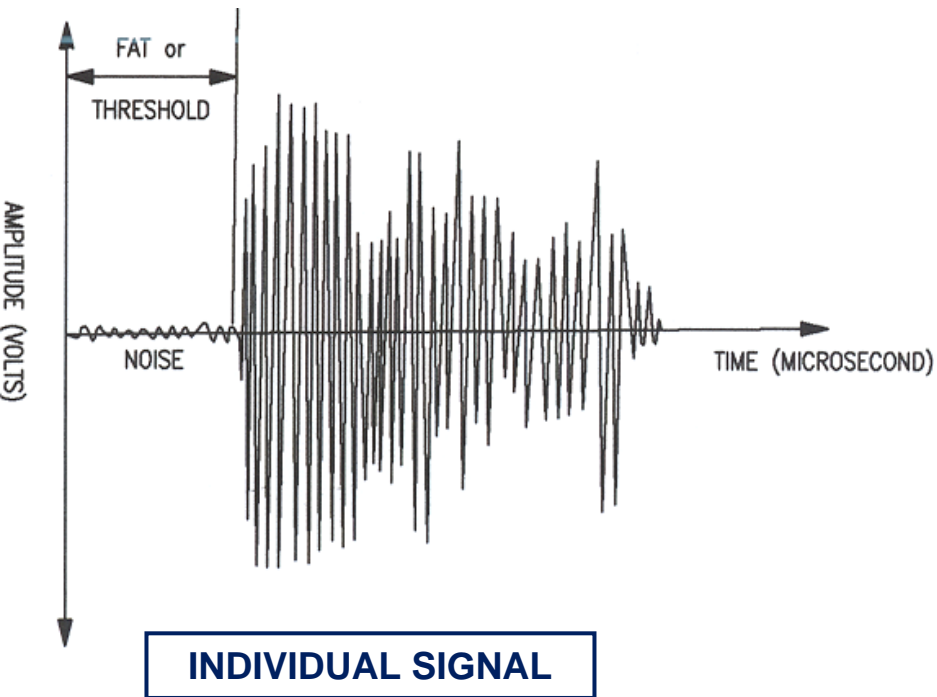
CSL

- Proven Technology
- Concrete Evaluation
- Repair Evaluation



CSL ANALYSIS

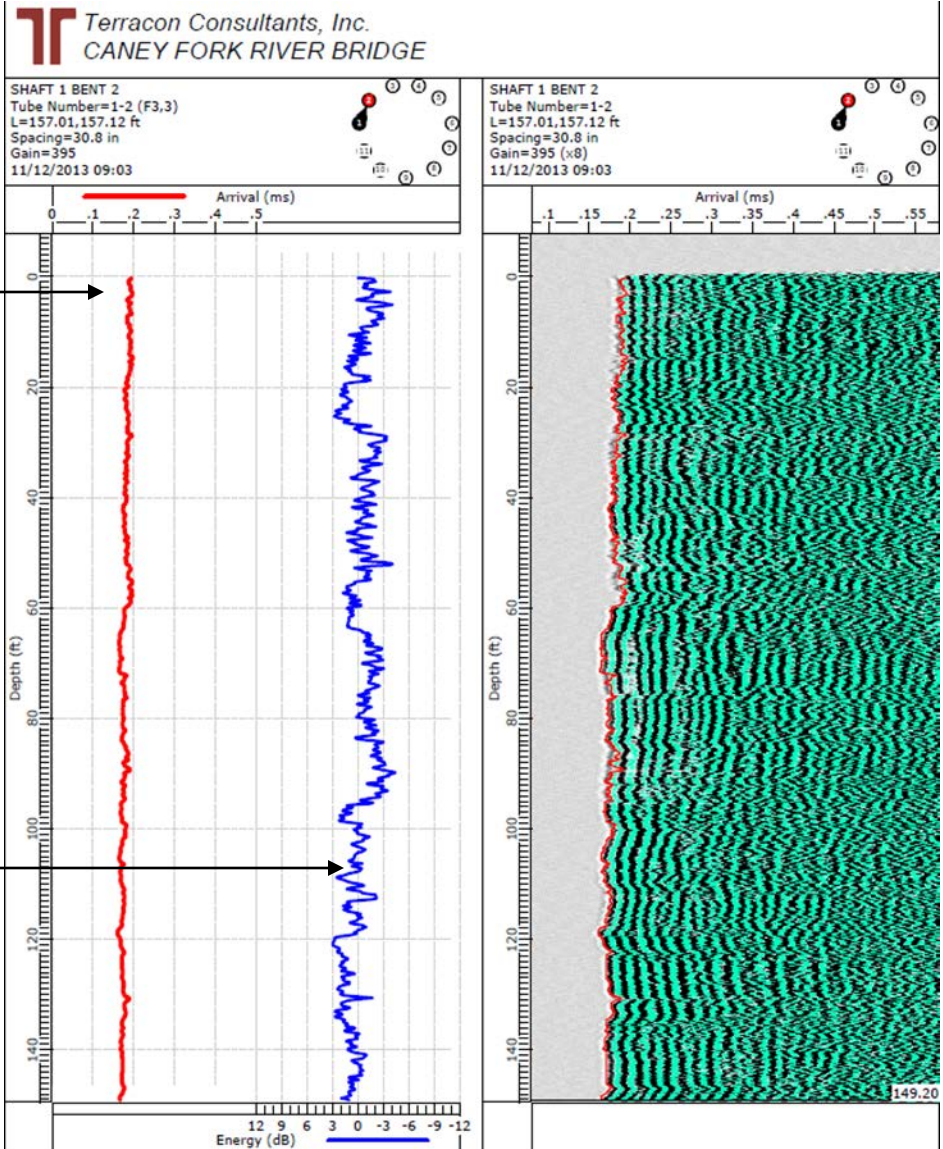
FAT = First Arrival Time



WHAT AFFECTS SIGNAL?

- Low density concrete
- Voids
- Soil Intrusions

CSL



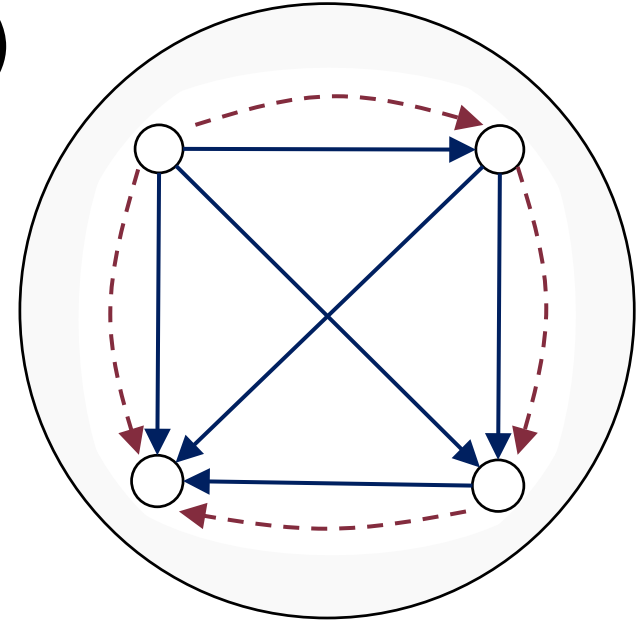
Arrival Time

Energy

Waterfall

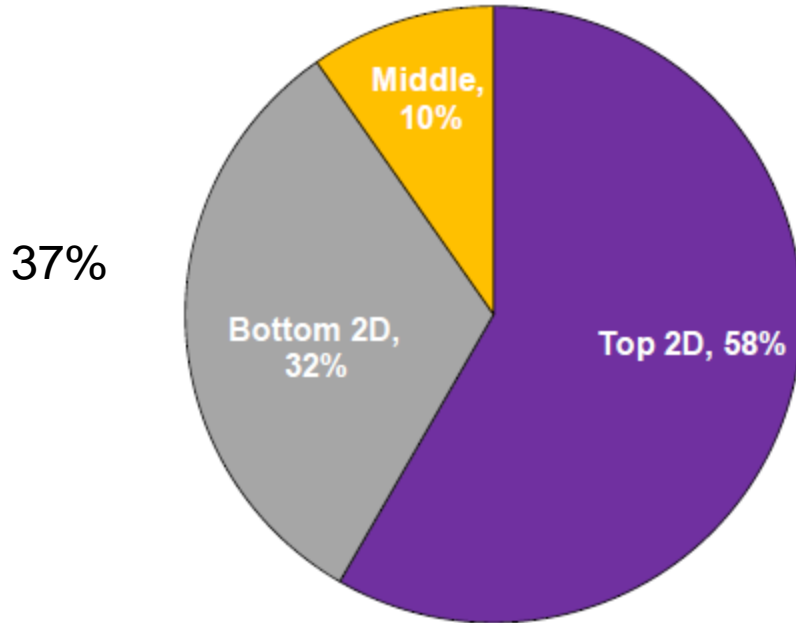
CSL

- Time Delay (Typ. 3-7 Days)
- Requires Access Tubes
- Testing within cage
 - 25% - 75%*
- False Positives/*Debonding*

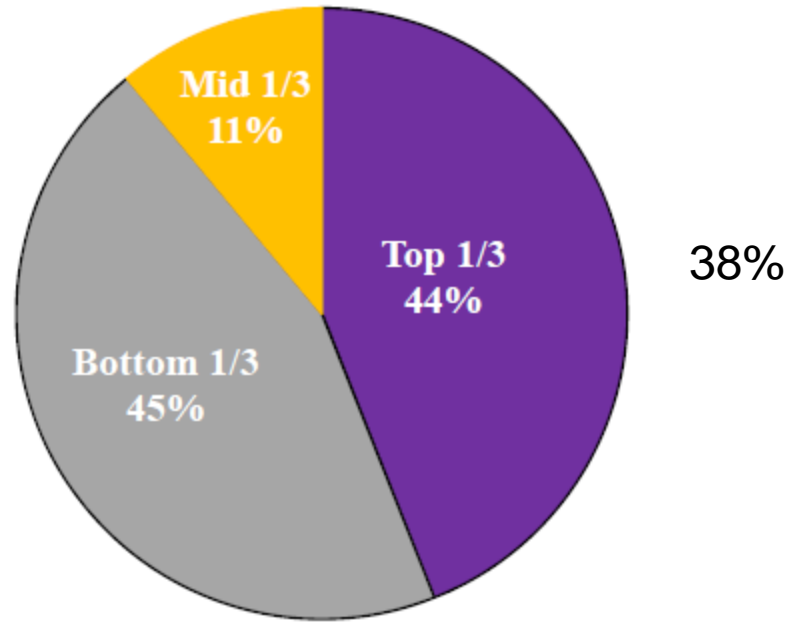


*Mullins, Winters (2011) *Infrared Thermal Integrity Testing Quality Assurance Test Method to Detect Drilled Shaft Defects*

CSL ANOMALIES



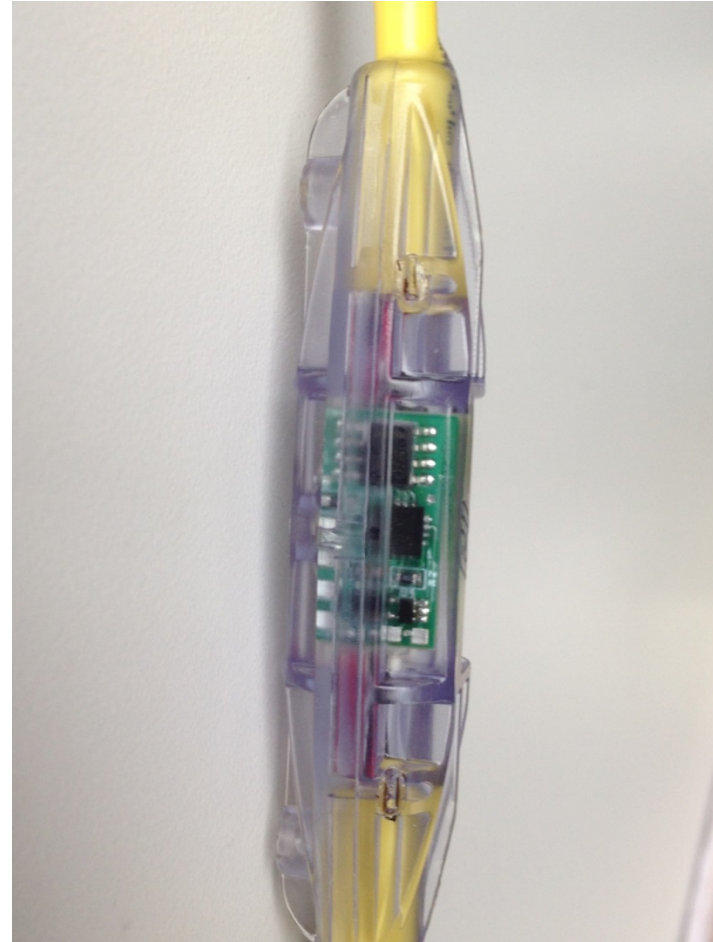
Bill Camp, S&ME Inc
“CSL of SC Drilled Shafts:
A Ten Year Summary”
ADSC Expo 2012,
San Antonio, March 2012



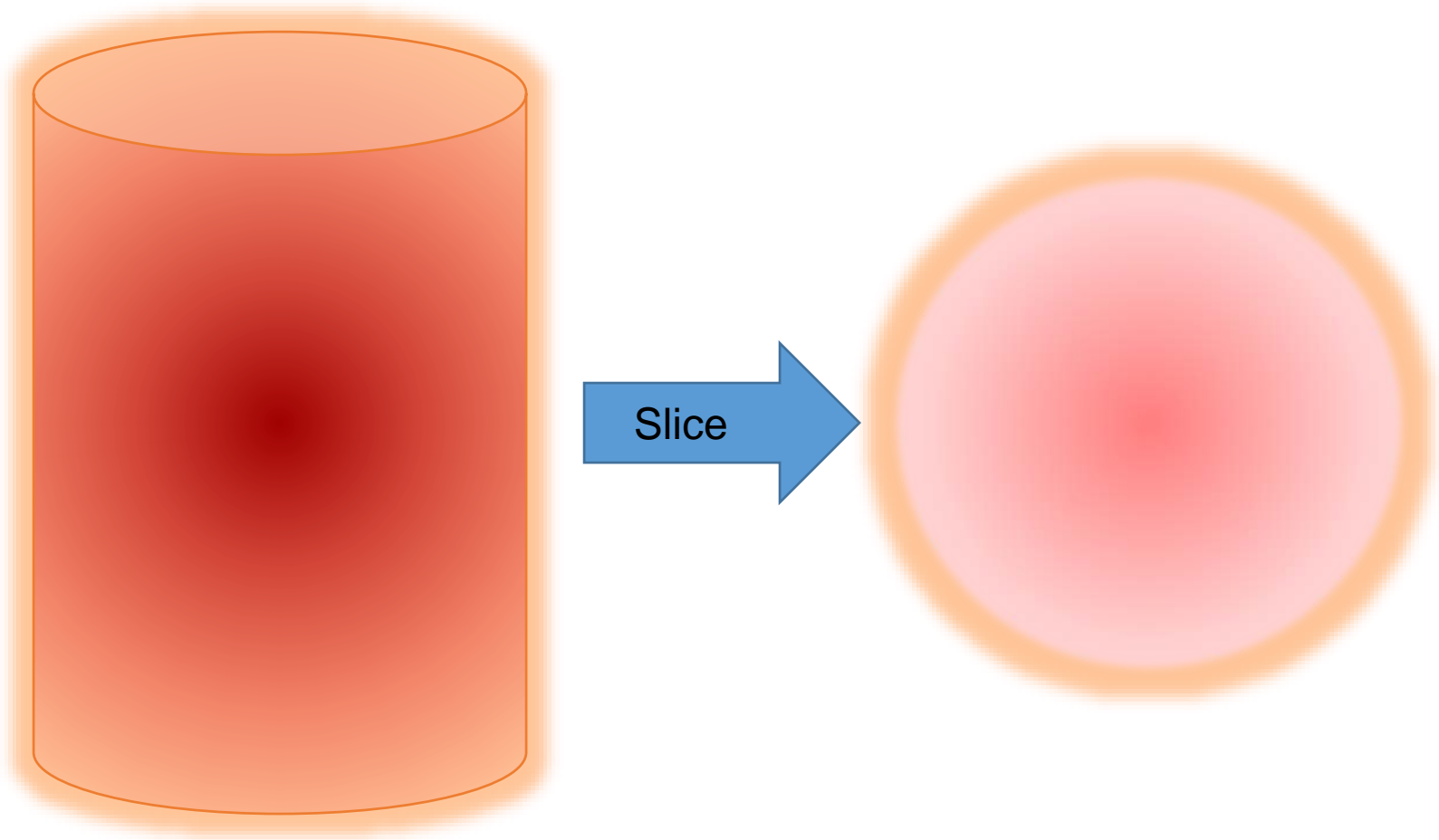
Jones & Wu, Geotechnology, Inc
“Experiences with CSL and Concrete
Coring for Verification of Drilled Shaft
Integrity”
ADSC GEO3
Construction QA/QC Technical Conference,
Dallas November 2005

THERMAL INTEGRITY PROFILING

AS DIAGNOSTIC TOOL

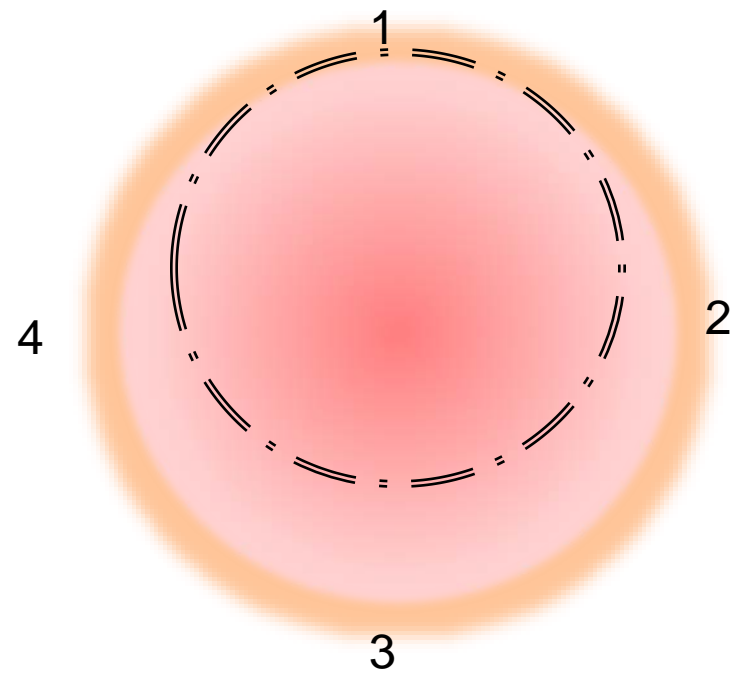
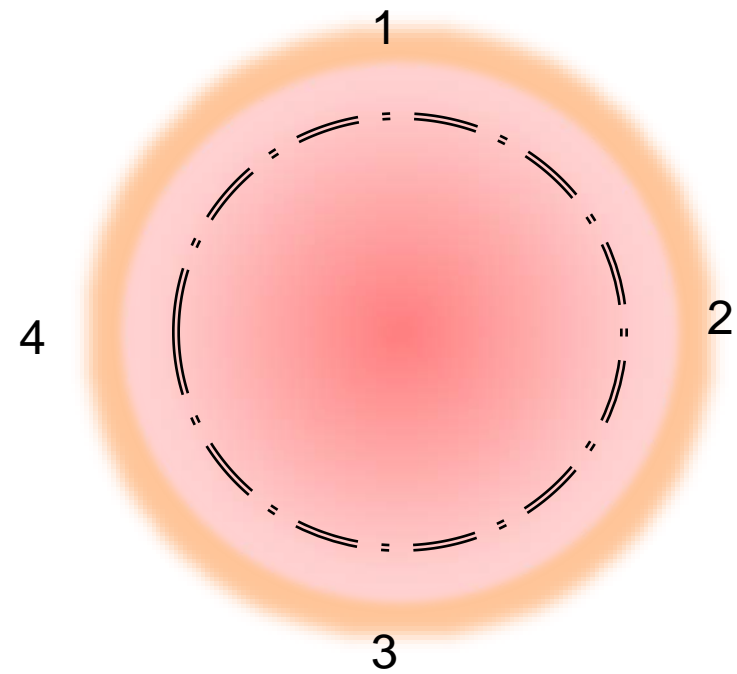


THERMAL INTEGRITY PROFILING

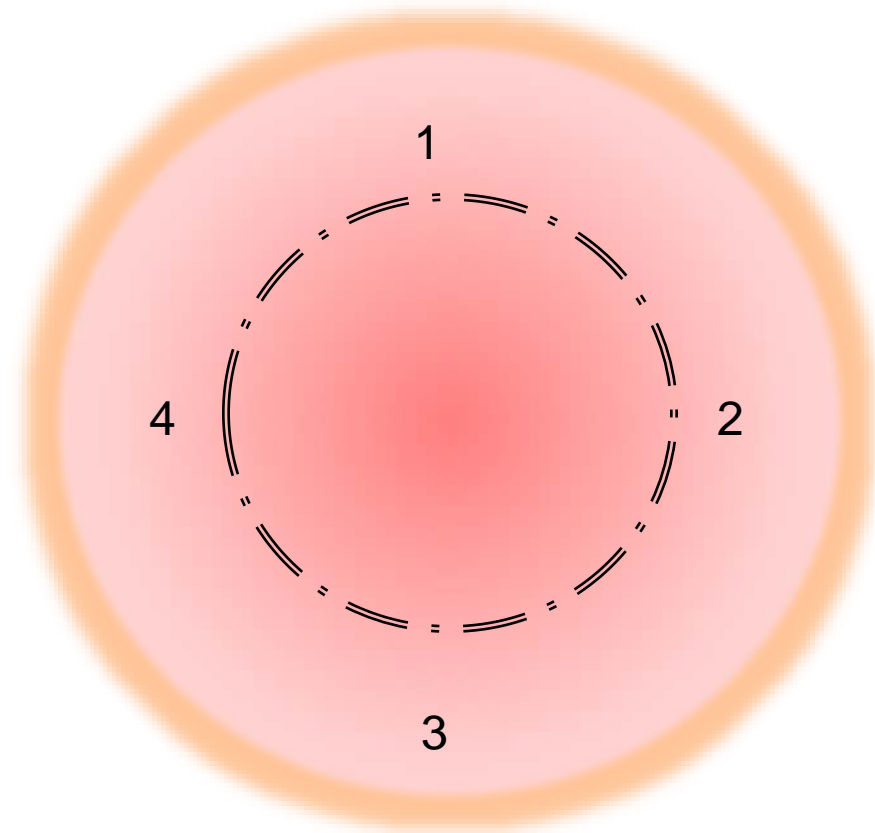
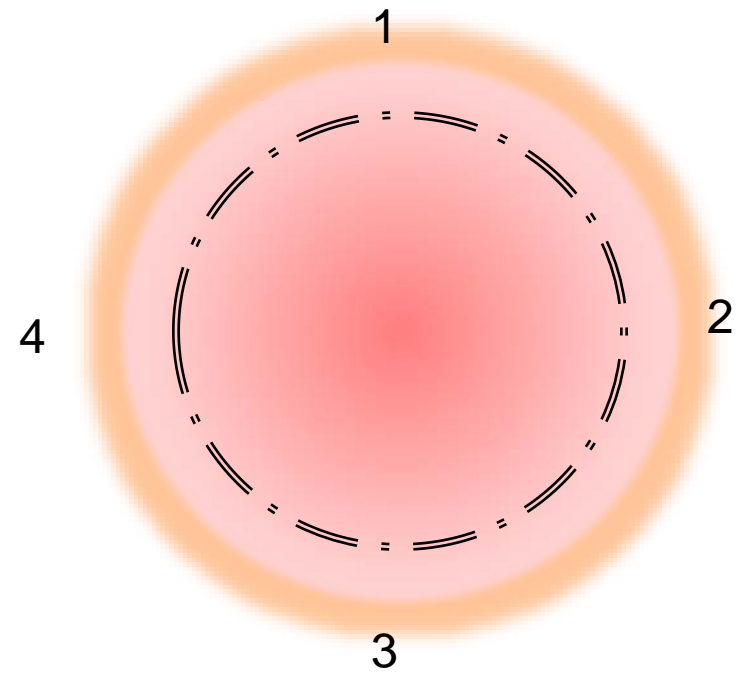


THERMAL INTEGRITY PROFILING

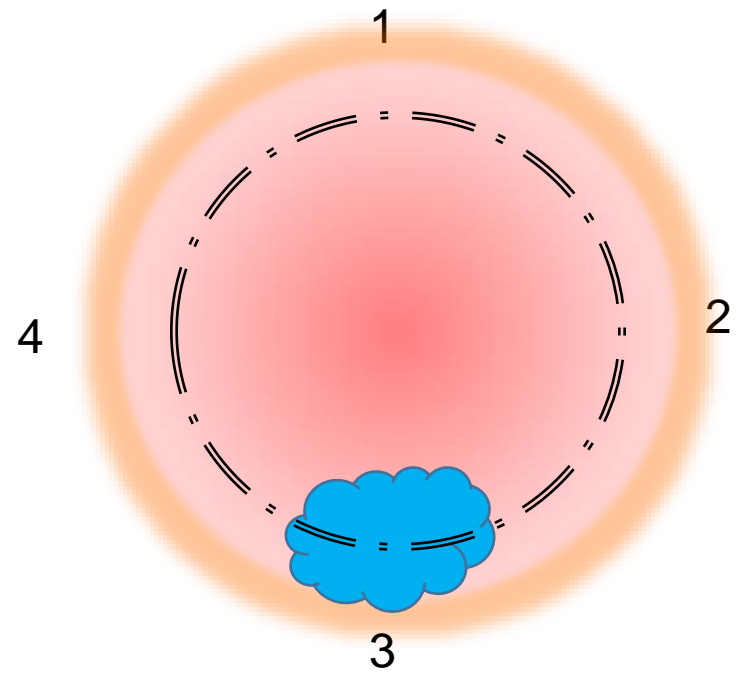
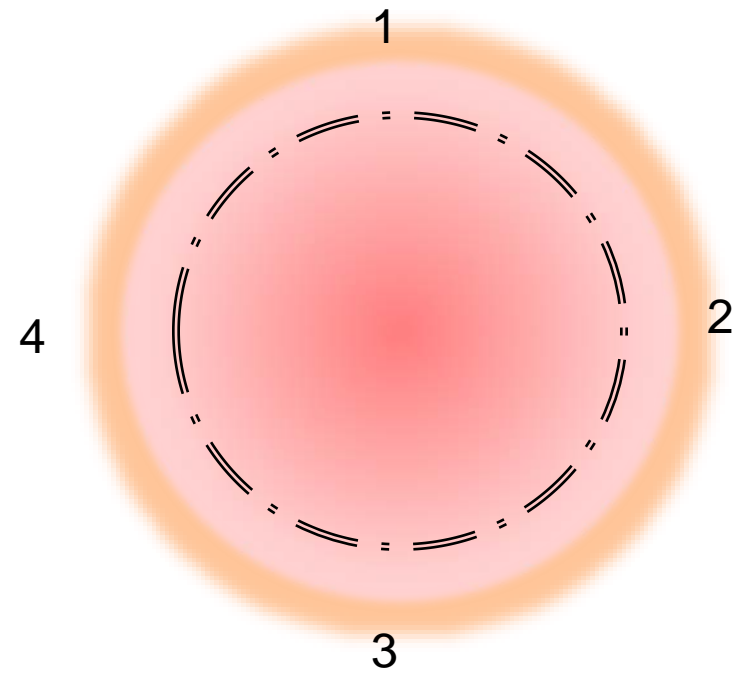
CAGE SHIFT



THERMAL INTEGRITY PROFILING ANOMALY



THERMAL INTEGRITY PROFILING ANOMALY



THERMAL



Example 1

DE-WATERING



Example 1

TEMPERATURE VS DEPTH

Example 1

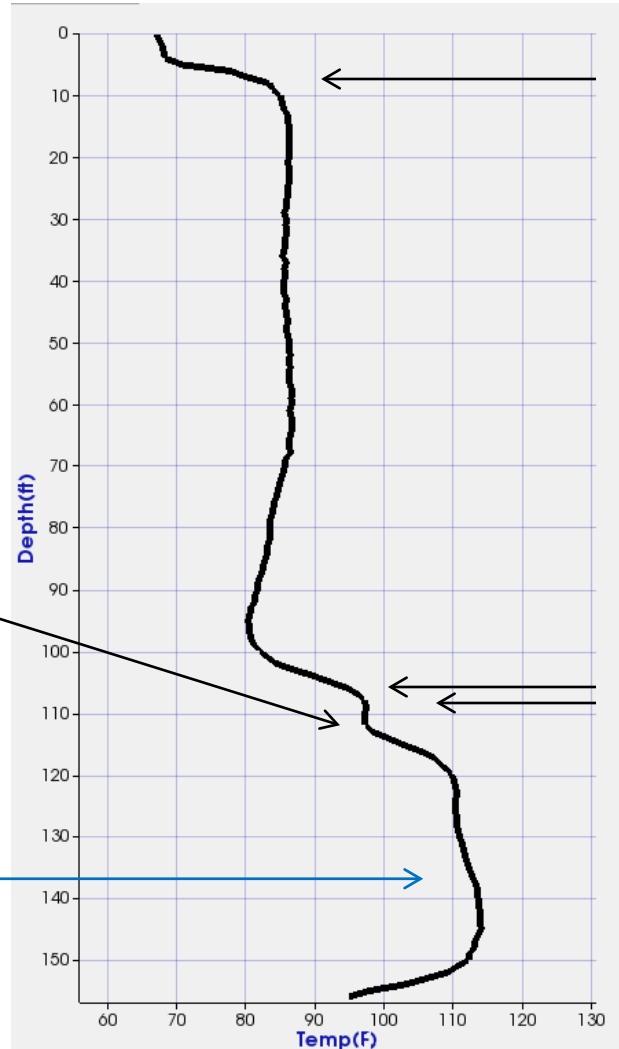
Tube 1

132 cy
theoretical

198 cy
actual

Bulge

Bottom of casing



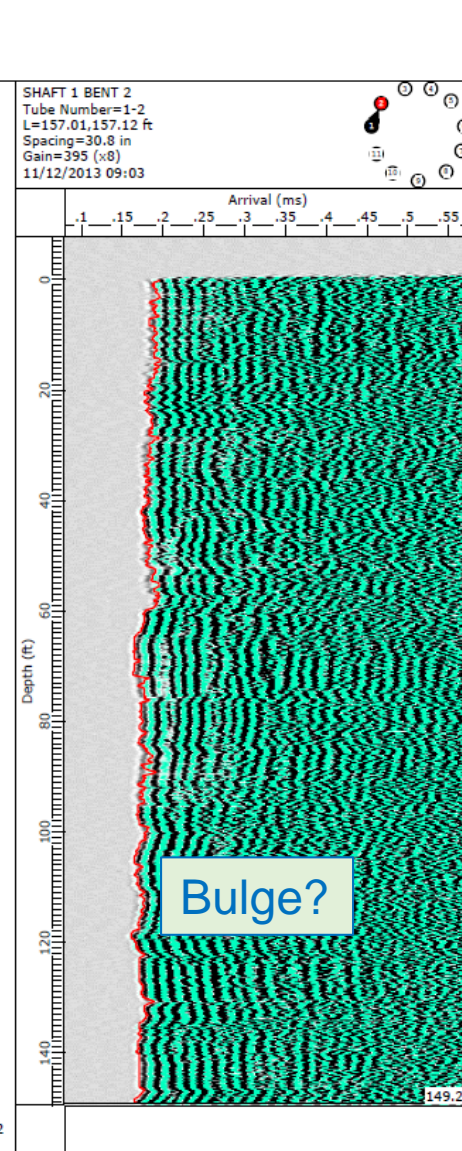
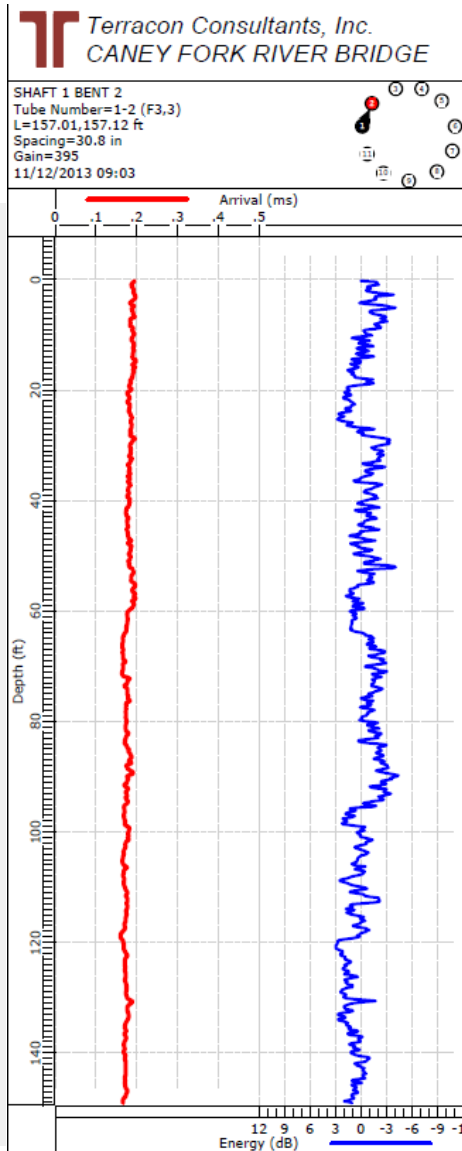
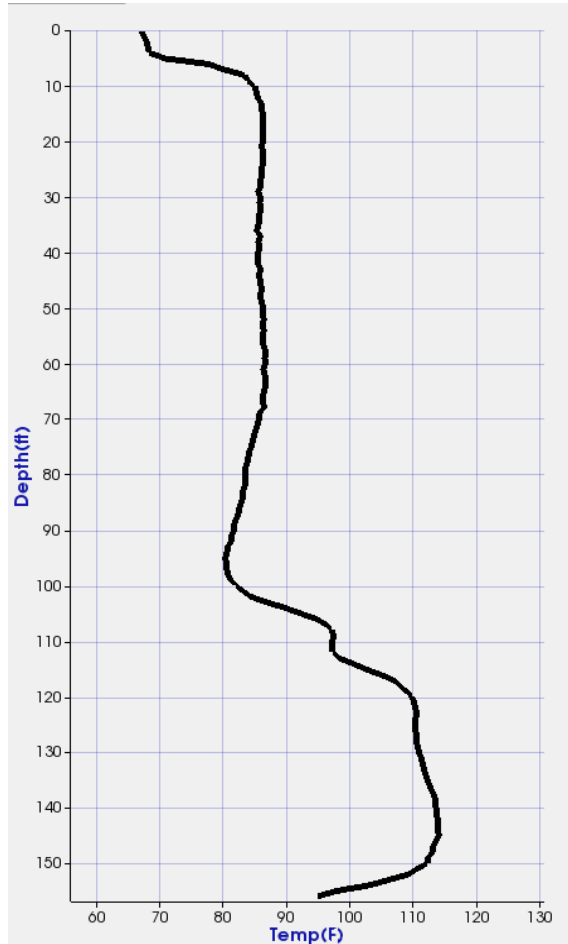
Top of river &
Top of shaft

Bottom of river

Shaley Limestone

CSL Vs THERMAL

Example 1



CSL Vs THERMAL

Example 1

Can evaluate bulges for
increased capacity

BENEFIT

THERMAL PROBE



Example 2
Little River
Tallahassee

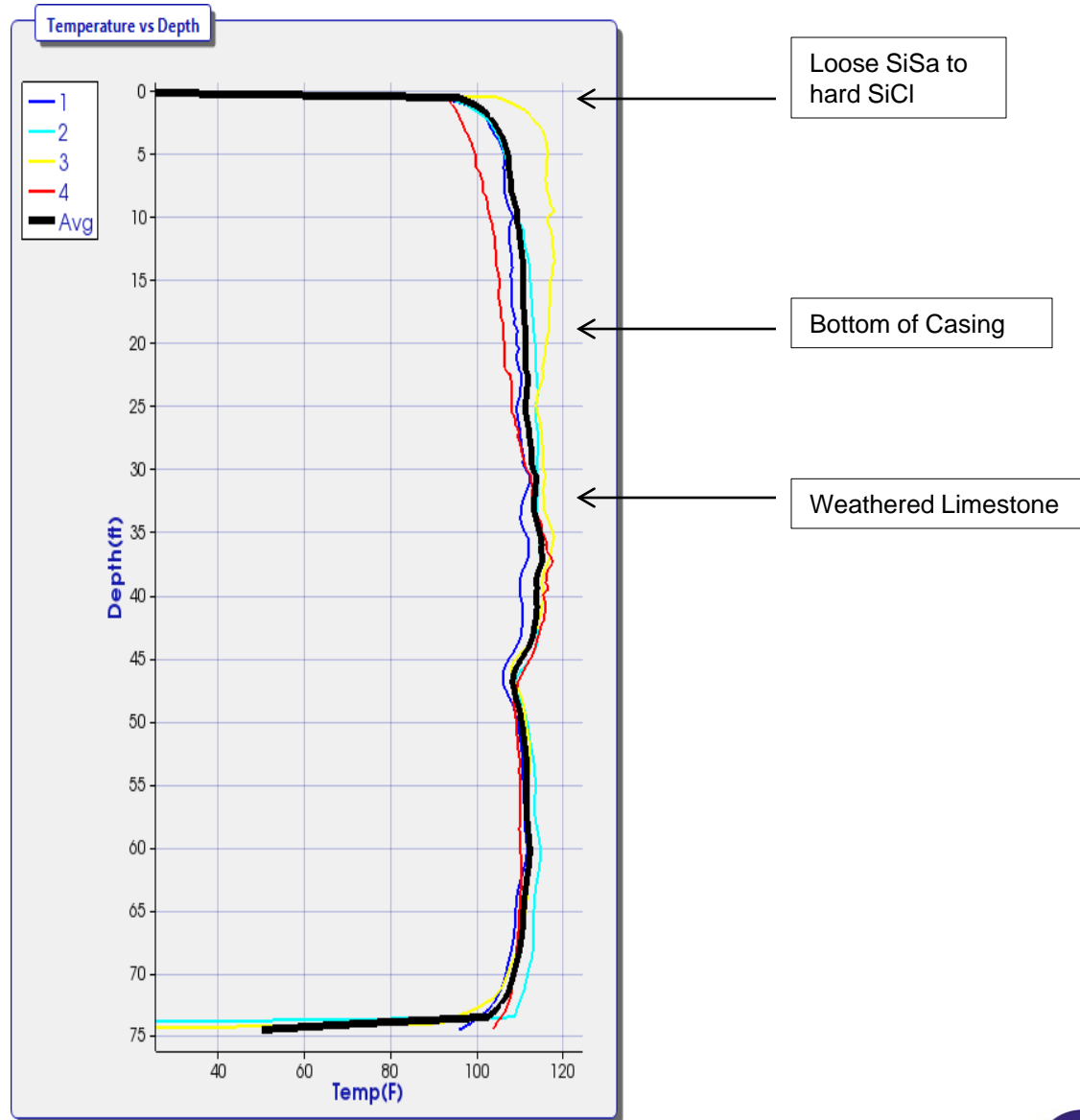
THERMAL PROBE



Example 2

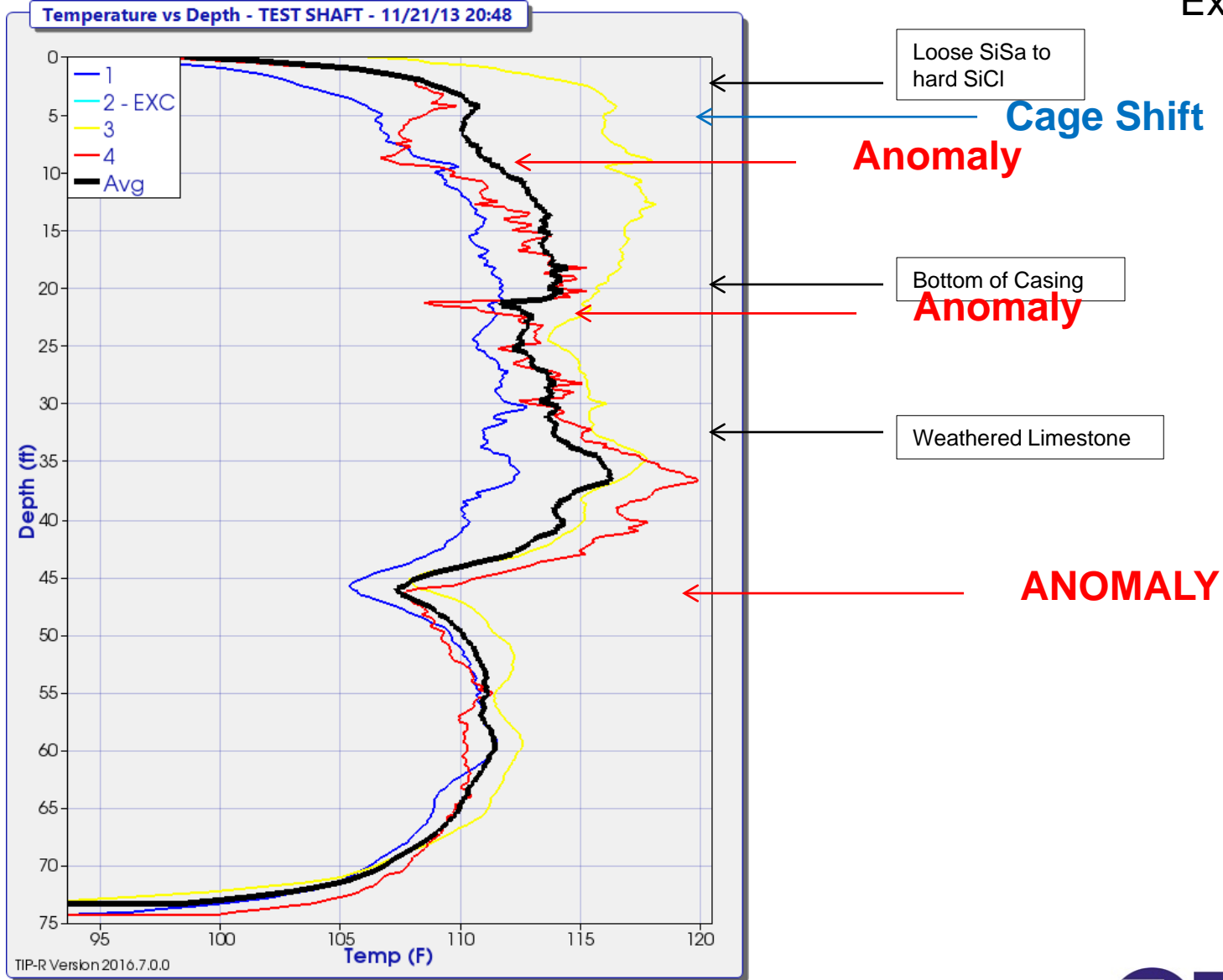
THERMAL RESULTS

Example 2



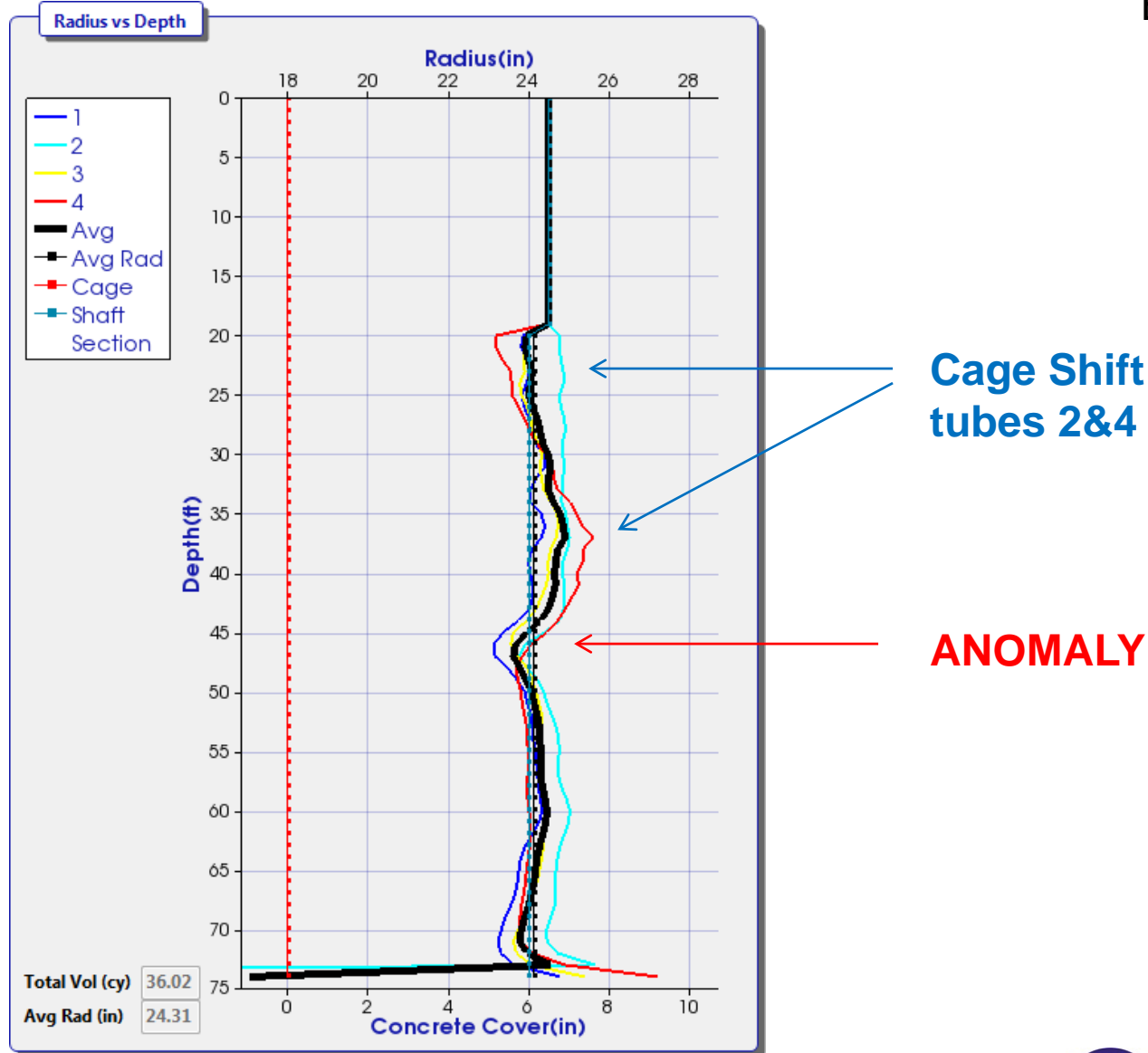
THERMAL RESULTS

Example 2



THERMAL RESULTS

Example 2



THERMAL RESULTS

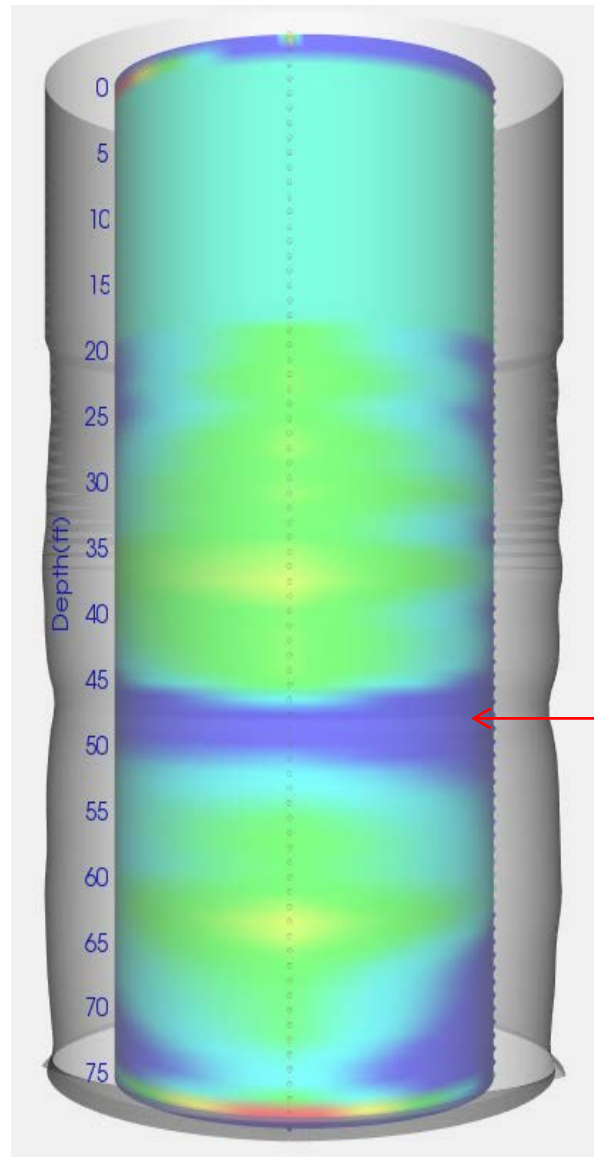
Example 2



← ANOMALY

THERMAL MODEL OF SHAFT

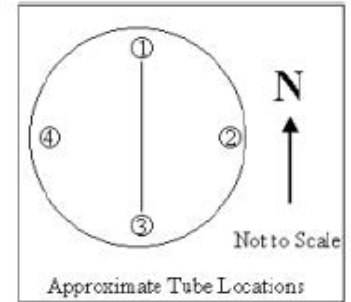
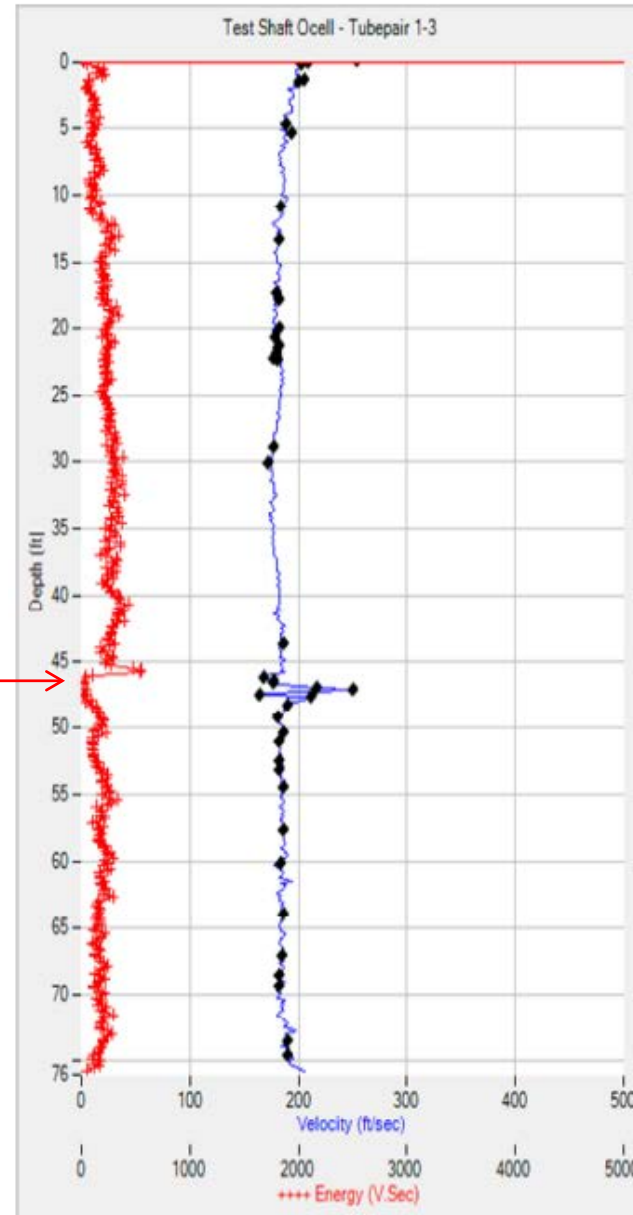
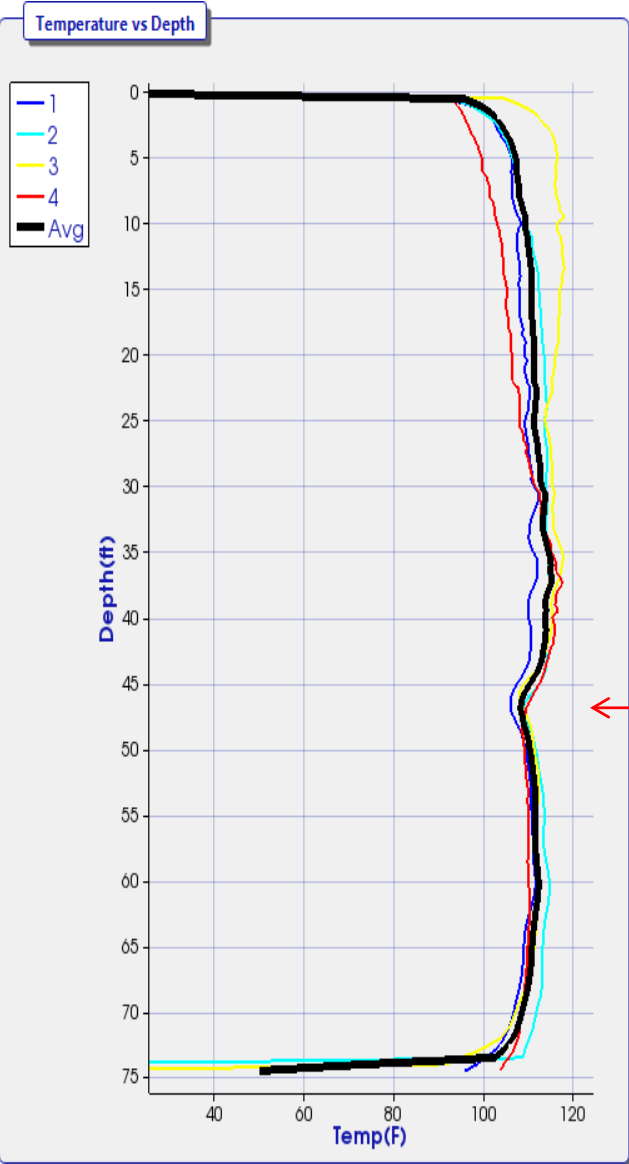
Example 2



Osterberg Cell

CSL vs THERMAL

Example 2



Shaft Name - Test Shaft Ocell
Test Date - 1/13/2013
Tube Spacing - 30
Tubepair Depth - 75.71 ft
Gain - 500

THERMAL ANALYSIS

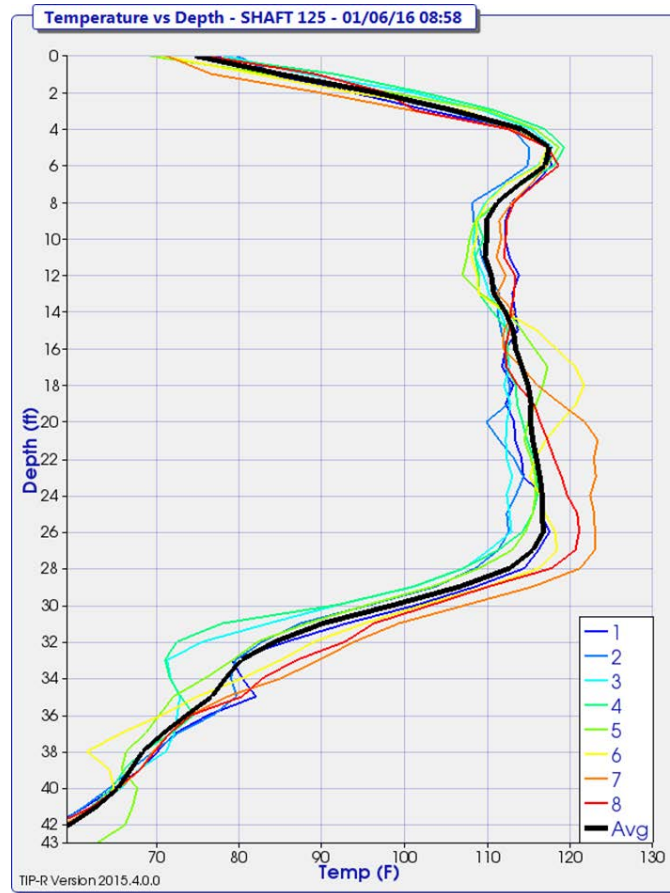
Example 3

96 inch diameter
43 ft long
48° ambient temperature



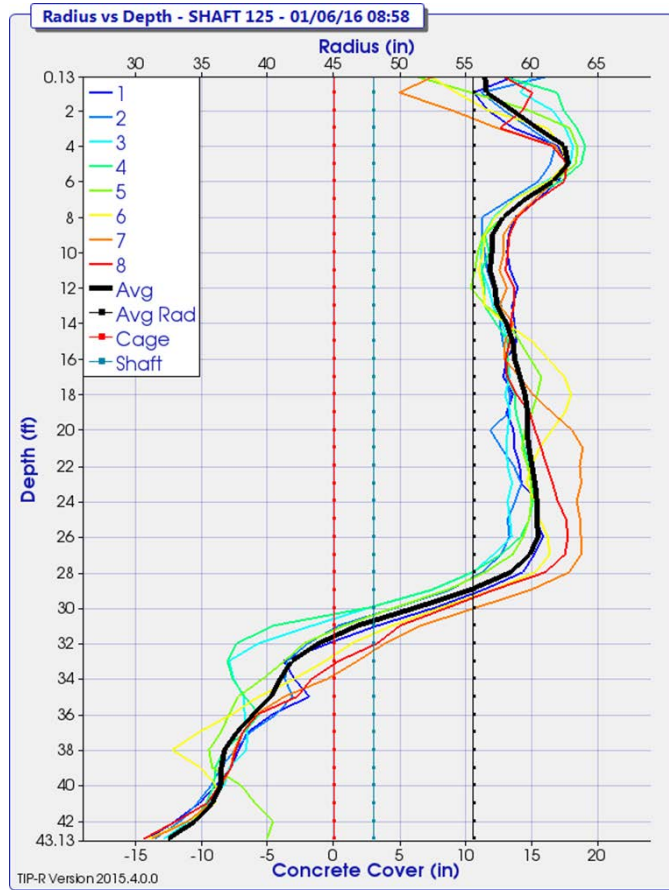
THERMAL ANALYSIS

Example 3



THERMAL ANALYSIS

Example 3

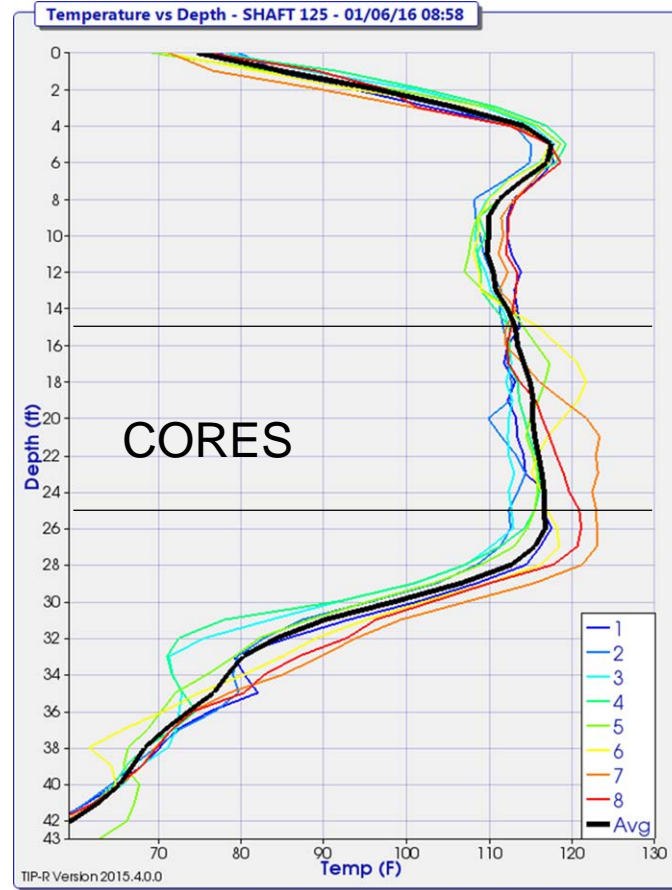


THERMAL ANALYSIS

Example 3



Structure 125 – Southwest Core. Concrete cores from 15 to 25 feet.

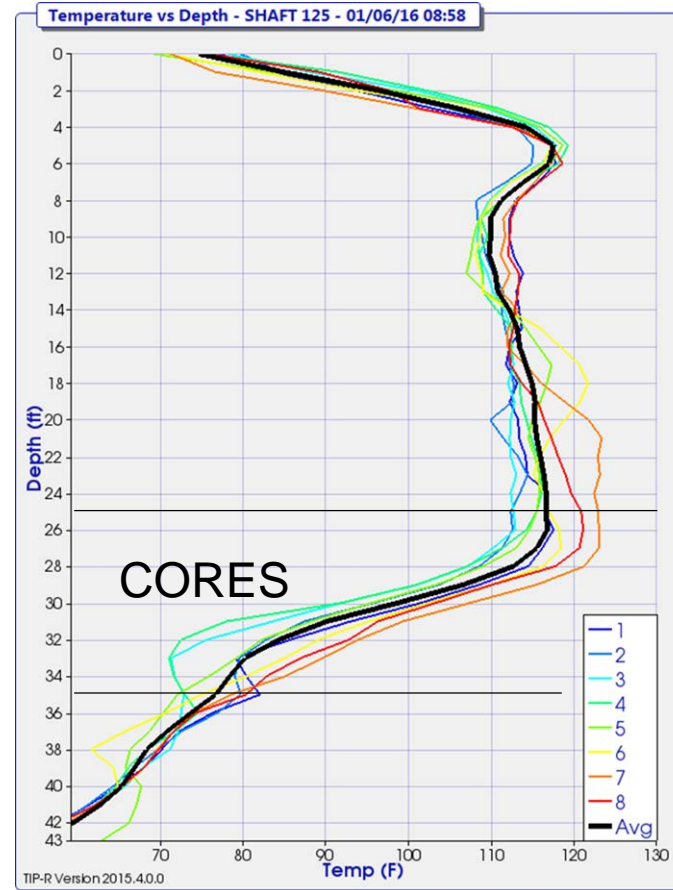


THERMAL ANALYSIS

Example 3



Structure 125 – Southwest Core. Concrete cores from 25 to 35 feet.

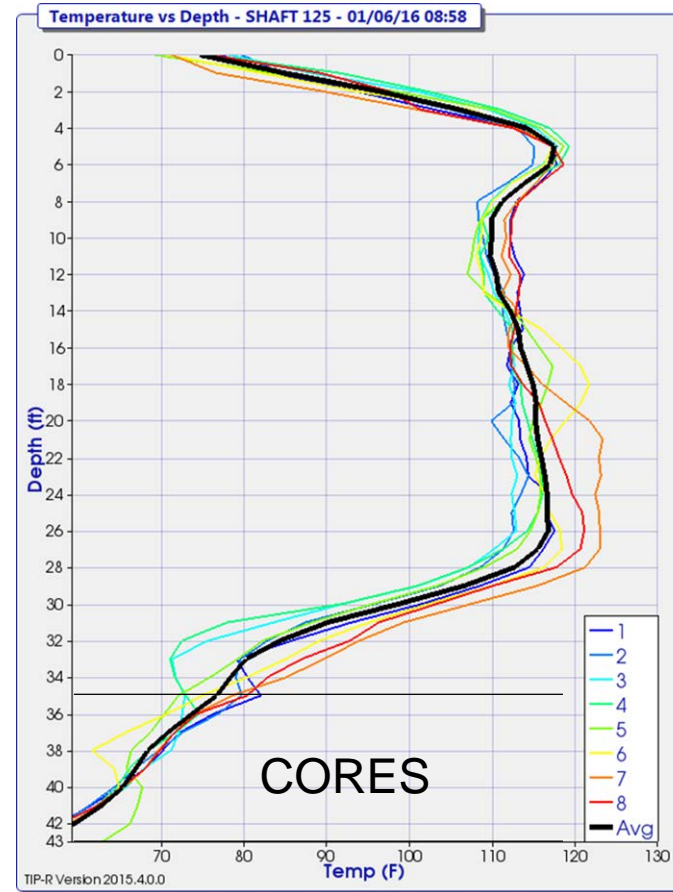


THERMAL ANALYSIS

Example 3



Structure 125 – Southwest Core. Concrete cores from 35 to 44 feet.



THERMAL ANALYSIS

Example 3

Allows for on the fly
corrective actions during
construction

BENEFIT

SUMMARY

Diagnostic Tool for

- Integrity
- Anomalies
- Cage Alignment
- Concrete Cover

BENEFITS

- No False Anomalies from Tube de-bonding
- Speed
- Correct Construction Techniques
- Easy Coring if necessary
- Evaluate Additional Capacity

Terracon

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RESOURCEFUL.
RELIABLE.**

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Environmental



Facilities



Geotechnical



Materials