CSL

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

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

• Proven Technology
• Concrete Evaluation
• Repair Evaluation
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

CSL ANOMALIES

37%

Bottom 2/3, 32%
Top 2/3, 58%
Middle, 10%

38%

Bottom 1/3, 45%
Mid 1/3, 11%
Top 1/3, 44%

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

[Images of thermal integrity profiling tools]
THERMAL INTEGRITY PROFILING
THERMAL INTEGRITY PROFILING
CAGE SHIFT
THERMAL INTEGRITY PROFILING

ANOMALY
THERMAL INTEGRITY PROFILING
ANOMALY
De-Watering

Example 1
TEMPERATURE VS DEPTH

Example 1

Tube 1

- Top of river & Top of shaft
- Bottom of casing
- Bottom of river
- Shaley Limestone
- Bulge

132 cy theoretical
198 cy actual
CSL Vs THERMAL

Example 1

Bulge?
Example 1

Can evaluate bulges for increased capacity
THERMAL PROBE

Example 2
Little River
Tallahassee
THERMAL PROBE

Example 2
THERMAL RESULTS

Example 2

- Loose SiSa to hard SiCl
- Bottom of Casing
- Weathered Limestone
THERMAL RESULTS

Example 2

Cage Shift
Loose SiSa to hard SiCl

Anomaly
Bottom of Casing

Anomaly
Weathered Limestone

ANOMALY
THERMAL RESULTS

Example 2

Cage Shift tubes 2&4

ANOMALY
THERMAL RESULTS

Example 2

ANOMALY
THERMAL MODEL OF SHAFT

Example 2

Osterberg Cell
CSL vs THERMAL

Example 2

Anomaly Cage Shift

O-cell

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

Temperature vs Depth

Depth (ft)

Temp (F)

O-cell

Test Shaft Ocell - Tubepair 1-3

Velocity (ft/sec)

Energy (V.Sec)
THERMAL ANALYSIS

Example 3

96 inch diameter
43 ft long
48° ambient temperature
THERMAL ANALYSIS

Example 3
Example 3
THERMAL ANALYSIS

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

Example 3

Temperature vs Depth - SHAFT 125 - 01/06/16 08:58

Temperatures at various depths for shaft 125.
THERMAL ANALYSIS

Example 3

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

Temperature vs Depth - SHAFT 125 - 01/06/16 08:58

CORES
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
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