Electronic Soil Test Logging

Strategic Advantage or Unnecessary Headache?
The Plan
What is it?

Digitally Recording Soil Test Data
Why?

- Eliminate duplicate logging
- Reduce lag time
  - Field to lab, lab to client
- Standardize logging, validate entry
- Better communication
  - Field – Office – Client
Traditional Work Flow

Field → Sample Review → Digital Entry

Lab Assign
Digital Field Logging Work Flow

Field

Lab Assign

Timely Input

Analysis
Why?

- Eliminate duplicate logging
- Reduce lag time
  - Field to lab, lab to client
- Standardize logging, validate entry
- Better communication
  - Field – Office - Client
Hardware Options

- Laptop
- Windows tablet
- iPad
- Panasonic ToughPad – Android
- PDA
Hardware Factors

- Battery Life
- GPS
- Glare Resistance
- Ruggedness
- Camera
Software Options

• gINT (Full or Simplified)
• Dataforensics pLog
• MS Excel / Access
• Internal Development
Software Options – Correspondence File
Software Factors

• Learning Curve / Entry Speed

• Customizable Database Structure (Yet Consistent)

• Longevity

• Syncing Procedure (Hardwire, Cloud, Direct Network Link)
IH-35E

- $4.8B
- Dallas, TX
- Fast-paced DB
- Rebuild 28-mi corridor
- 481 borings
- 12 to 125 feet deep
- 16,600 LF
- 3 to 5 rigs day/night for 6+ months
IH-35E

- 5 Panasonic ToughPads with pLog
- Cloud upload on daily basis
- Import via PC gINT
- Assign lab
Dataforensic’s pLog

Core principals

1. Minimize text input
   • buttons, checkboxes, and pull-down lists.

2. Customizable

3. Real-time data upload

4. Data entry validation
   • cannot choose “very loose clay”

5. Integrate logging, digital photographs, and GPS

Needed Before Public Release

Courtesy Dataforensics
pLog

Projects

Sampling Plans

Email Logs

Preview Logs

Preferences

Sync

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Version 7.03.27

Courtesy Dataforensics
<table>
<thead>
<tr>
<th>B-1</th>
<th>B-2</th>
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<tbody>
<tr>
<td>Soil Sample</td>
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<tr>
<td>Shear Strength</td>
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<tr>
<td>Groundwater Info</td>
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<td>Stratigraphy</td>
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<tr>
<td>Strata Detail</td>
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<td>Rock Sample</td>
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<td>Environmental Data</td>
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<td>Color</td>
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<td>Structure</td>
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<td>Comments</td>
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*Courtesy Dataforensics*
<table>
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<tr>
<th>Depth</th>
<th>Description</th>
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<tbody>
<tr>
<td>0.0 - 1.0</td>
<td>ASPHALT, 40% sand, 20% gravel, 20% fines, clay, SC, ORGANIC GRVEL, CLAYEY SAND trace (B-1) base core, 20% very loose, may contain sand, free falling, very loose to loose, comments</td>
</tr>
<tr>
<td>1.0 - 5.5</td>
<td>Manganese with (12-35%) roots, light brown gley to dark olive green, stratified, yellow, gray, soil layer, very loose, dry to moist, very loose to loose, comments</td>
</tr>
<tr>
<td>5.5 - 11.0</td>
<td>50% sand, 50% gravel, 0% fines, SP GRAVEL, SAND trace, thin, dark brown, FC, moist, very loose to loose, comments</td>
</tr>
<tr>
<td>11.0 - 15.0</td>
<td>70% sand, 10% gravel, 20% fines, SG CLAYEY SAND trace (6-12%) fine gravel, brown, red, dry, moldy, loose, comments</td>
</tr>
<tr>
<td>15.0 - 22.0</td>
<td>Poorly graded, SP SAND, gray, residuum, mold, Rock Layer, very thickly bedded, dark brown, bedded rock, extremely weak rock, very weak rock, weathered rock, comments</td>
</tr>
<tr>
<td>22.0 - 24.0</td>
<td>10% sand, 0% gravel, 50% fines, CLAYEY SAND trace (5-12%) fine sand, orange and brown, sand, comments, residuum, rock, Rock Layer, very thickly bedded, dark brown, bedded rock, extremely weak rock, very weak rock, weathered rock, comments</td>
</tr>
<tr>
<td>24.0 - 35.0</td>
<td>80% sand, 0% gravel, 20% fines, silt, SM SILTY SAND, gray to brown, wet, Rock Layer, very thickly bedded, dark brown, bedded rock, extremely weak rock, very weak rock, weathered rock, comments</td>
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<tr>
<td>35.0 - 41.0</td>
<td>Fresh rock weathered, very coarse grained, coarse grained, Rock Layer, very thickly bedded, dark brown, very coarse grained, extremely weathered rock, comments</td>
</tr>
<tr>
<td>41.0 - 45.0</td>
<td>Fresh rock weathered, very thickly bedded, dark brown, very coarse grained, extremely weak rock, comments</td>
</tr>
</tbody>
</table>
# BORING NUMBER B-1

## Details

- **Client**: The Client
- **Project Number**: 2013-SLD-A
- **Date Started**: 2013-09-03
- **Date Completed**: 2013-09-03
- **Drilling Contractor**: Scott Beaton
- **Drilling Method**: 4-1/4" Solid stem auger
- **Logged By**: Scott Beaton

## Groundwater Levels:
- **After Drilling**: 15.0 ft / Elev 116.0 ft
- **End of Drilling**: 15.0 ft / Elev 116.0 ft

## Material Description:

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
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<tbody>
<tr>
<td>CL</td>
<td>dark blackish gray to light grayish brown, LEANCLAY WITH SAND, CL, poorly graded</td>
</tr>
<tr>
<td>SC</td>
<td>dark gray, very tene, CLAYEY SAND, SC</td>
</tr>
<tr>
<td>CL</td>
<td>dark blackish gray to light grayish brown, LEANCLAY WITH SAND, CL, poorly graded</td>
</tr>
</tbody>
</table>

## Graphs and Data

- Various graphs and data related to soil analysis and boring logs.
**Project Details**

- **Name**: IH-35E Managed Lanes
- **Project ID**: 94139094
- **City**: Dallas and Denton Counties
- **State**: Texas
- **Client**: AGL Constructors
- **Variable Column 1 Heads**: SULFATE
- **Variable Column 2 Heads**: LIME CONTENT
- **Depth Log Page (It)**: 36
- **Coef of Consol Factor**: Dallas
- **Compression Strength Unit**: tif

**gINT Options**

- **gINT Correspondence File**: N:\Projects\2013\02139094\Working Files\logs and gINT FOLDERS\PLOG\terracon...
- **Overwrite Options**: Empty Fields

**Filtering Options**

- **Select By**: Points
- **Points**: All points not in gINT, All points
- **Photos**: Include photos in download
Pros

• Battery Life
• Standardization

Cons

• Sun Glare
• Loss of Detail
• Software Navigation

Costs

• $1.5k to $2.5k per unit (plus hardware)
• $500 to $1k one time setup
Success Story

• Eliminates transcription errors
• Fast, accurate lab assignment
• Instant transmission of field logs to office or client
• Time saving
  - QA/QC “Check Print” procedure
  - “Saved 30 minutes per log”

“Could not have met accelerated schedule without it”
Lessons Learned

- Train up front
  - Accidental overwrite of final logs with field logs
- Intentional database management
- Full-time field engineer
CONSTRUCTION MATERIALS ENGINEERING AND LABORATORY MANAGEMENT SYSTEM (CMELMS™)

Real-Time Field and Laboratory Data Management and Reporting
What is CMELMS™?

- Field and laboratory testing data and results management system.
- Ease of reporting and documentation purposes.
- Real-time access to test results and reports.
- Internally developed.
Project Scheduling

Contractors e-mail or call-in request for services

Dispatch Report is created and saved in CMELMS™
Project Scheduling

Dispatch/Schedule Report is sent to Field Technicians and Project Managers via Smartphone for acceptance
Digital Field Data Collection and Mobile Communication

- Ability to collect and enter field test results digitally into CMELMS™
- Provides instant communications
- Expedites resolution of non-conformance issues
- Eases reporting and clarifies site conditions
Digital Field Data Collection and Mobile Communication

- Project specific or locally-regulated inspection forms and project design drawings are stored on our servers and are available for engineers/inspectors in the field.
- Field engineers/inspectors fill out forms, create sketches, and annotate drawings and photos.
Report Submittal

- **CMELMS™** tracks all reports in the system, provides immediate availability of data, including summaries of all density tests or concrete tests performed on the project, and can produce digital or paper copies of reports for distribution.

- Terracon’s Client Document Web Site allows for designated and approved members of the project team to view, print or download our inspection and test reports as they are uploaded daily to expedite report submittals, save on postage costs, and reduce the use of paper.
Electronic Logging via In-situ Testing
From: Mayne 2013
Digital Field Logging Work Flow

Field

Lab Assign

Timely Input

Analysis
Why?

PRIOR INFORMATION

- Geophysics
- Drilling & Coring
- Sampling
- In-Situ Testing

LABORATORY TESTING

THEORETICAL EVALUATIONS

ANALYTICAL METHODS

ENGINEERING ANALYSIS

NUMERICAL METHODS

GEOTECHNICAL SOLUTION

From Paul W. Mayne, PhD, P.E., Professor, Civil Engineering, GT.
Why?

GEOTECHNICAL SOLUTION
## Pros and Cons

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| SPT    | - Rigs & operators in place  
         - Many correlations  
         - Obtain sample | - Highly variable  
         - Crude number for analysis  
         - 5-ft intervals |
| CPT    | - Fast and continuous  
         - Operator independent  
         - 3+ measurements  
         - Strong basis for correlations | - High capital investment  
         - Requires skilled operator  
         - Electronics  
         - No soil samples |
| DMT    | - Operator independent  
         - Direct lateral measurement  
         - Strong basis for correlations | - Difficult to push in dense materials  
         - Calibration for local soils |
CPT Analysis Reliability

*Improves with shear wave measurements

Terracon’s CPT Program
Terracon’s CPT Program

Field Test

Process
Data &
Correlations

Print Logs
(Standard & Correlative)

Engineering Analysis

- eToolbox
- CPeT-IT

Software
Terracon’s CPT Program
Terracon’s CPT Program
CPT Log

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Tip Resistance, q_t (lbf)</th>
<th>Sleeve Friction, f_s (lbf)</th>
<th>Friction Ratio (%)</th>
<th>Hydrostatic Pressure Pore Pressure, U_2 (lbf)</th>
<th>Material Description Normalized CPT Soil Behavior Type</th>
</tr>
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<tbody>
<tr>
<td>11</td>
<td>0.12</td>
<td>0.24</td>
<td>0.36</td>
<td>0.5</td>
<td>1 - Sensitive fine grained</td>
</tr>
<tr>
<td>22</td>
<td>0.24</td>
<td>0.36</td>
<td>0.48</td>
<td>0.5</td>
<td>2 - Organics with clay</td>
</tr>
<tr>
<td>33</td>
<td>1.0</td>
<td>3.6</td>
<td>4.4</td>
<td>0.5</td>
<td>3 - Silt clay - sandy</td>
</tr>
<tr>
<td>44</td>
<td>2.0</td>
<td>4.0</td>
<td>4.8</td>
<td>0.5</td>
<td>4 - Sand/organic - slightly clay</td>
</tr>
</tbody>
</table>

CPT Terminated at 20.6 Feet

See Exhibit A-3 for the adjacent test's full details. CPT sensor calibration reports available upon request.

WATER LEVEL OBSERVATION

- 8 ft estimated water depth (used in normalizations and correlations; see Appendix C)

See Exhibit A-2 for surface elevations. Approximate Surface Elev: 11 ft +/- Adjacent Test: HAB-1
Latitude: 33.6702° Longitude: -78.9472°

PROJECT: Anderson Brothers Bank
CLIENT: inForm Studio
SITE: Myrtle Beach, South Carolina
Latitude/Longitude: Charleston, SC

CPT LOG NO. CPT-1

Page 1 of 1

TEST LOCATION: See Exhibit A-2

LATITUDE: 33.6702°
LONGITUDE: -78.9472°

CPT Started: 10/23/2012
Rig: Pagans TQ73-200
Operator: B. Robler

CPT Completed: 10/23/2012
Project No.: Horry County
Exhibit: A-4
CPT Log

CPT LOG NO. SCPT-2

PROJECT: Anderson Brothers Bank
CLIENT: inForm Studio
SITE: Myrtle Beach
South Carolina, ER125010

Latitude/Longitude
Charleston, SC

TEST LOCATION: See Exhibit A-2
Approx. Surface Elev: 10 ft +/-
Adjacent Test: HAB-2
Lat: 33.6703°
Long: -78.947°

Depth (ft)
Tip Resistance, q, (tsf)
Sleeve Friction, fs (tsf)
Friction Ratio (%)
Hydrostatic Pressure
Pore Pressure, U2 (tsf)
Shear Wave Velocity, Vs (ft/sec)
Material Description
Normalized CPT
Soil Behavior Type

Material
1.2 3.4 5.6 7.8
Data
Approx.
Elev. (ft)

See Exhibit A-3 for description of field procedures.
See Appendix C for explanation of symbols and abbreviations.

CPT Terminated at 33.1 Feet

Only display if have data
Correlated Parameters CPT Log

1. Tip Resistance
2. Skin Friction
3. Friction Ratio
4. Pore Pressure
5. Shear Wave Velocities
6. Adjacent Boring Description
7. Unit Weight
8. Vertical Stress
9. N60 Value
10. Push Rate
11. Shear Strength
12. Sensitivity
13. OCR
14. Effective Friction Angle
15. Hydraulic Conductivity
16. Small Strain Modulus
17. Elastic Modulus
18. Constrained Modulus
19. Tilt Angles
20. Relative Density
Other CPT Features

Strata
Other CPT Features
Other CPT Features
Automated Fence
DMT Log

DMT LOG NO. DMT-3

PROJECT: Anderson Brothers Bank
CLIENT: inForm Studio
Myrtle Beach, South Carolina

SITE: Myrtle Beach
South Carolina, ER125010

Latitude/Longitude
Charleston, SC

TEST LOCATION: See Exhibit A-2
Approx. Surface Elev: 12 ft +/-
Adjacent Test: HAB-3
Latitude: 33.6703°
Longitude: -78.9469°

Depth (ft)
0.4 0.8 1.2 1.6
Contact Stress, p0 (tsf)

1.1 2.2 3.3 4.4
Expansion Stress, p1 (tsf)

Thrust, P (tons)

25 50 75 100
Dilatometer Horizontal Stress Index, KD

240 480 720 960
Dilatometer Modulus, ED (tsf)

Material Description
DMT Soil Behavior Type

Approx. Elev. (ft)

See Exhibit A-3 for explanation of symbols and abbreviations.
Elevation estimated from provided topographical map.

WATER LEVEL OBSERVATION

8 ft estimated water depth
used in normalizations and correlations,
see Appendix C.

Terracon
14000 Rd Street West
North Charleston, South Carolina

DMT Started: 10/23/2012
DMT Completed: 10/23/2012
Rig: Pagani TQ73-200
Operator: B. Ruter
Project No.: Horry County
Exhibit: A-4
Only display if have data
<table>
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<tr>
<th>Rig Type</th>
<th>Torque (ft-K)</th>
<th>Push (tons)</th>
<th>Pull (tons)</th>
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<th>Daily Prod.</th>
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<td>$90</td>
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<td>23</td>
<td>$200</td>
<td>$52</td>
<td>$32</td>
<td>275</td>
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<tr>
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<td>4.0</td>
<td>16</td>
<td>24</td>
<td>$300</td>
<td>$72</td>
<td>$44</td>
<td>200</td>
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<td>GP8040</td>
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<td>30</td>
<td>40</td>
<td>$450</td>
<td>$102</td>
<td>$61</td>
<td>200</td>
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<td>CPT Truck/ATV</td>
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<td>30</td>
<td>40</td>
<td>$500</td>
<td>$111</td>
<td>$67</td>
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<tr>
<td>Pagani/Truck</td>
<td>n/a</td>
<td>15 +/-</td>
<td>20</td>
<td>$100</td>
<td>$33</td>
<td>20</td>
<td>250</td>
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</table>
Recent Project – LSU Foundation

The Business Case

- 4 Soil Borings to 70 ft  (280 lf)  
  3 days to complete (90 lf/day)

- 5 CPT to 70 ft & 1 SCPT to 100 ft  (450 lf)  
  2 days to complete (225 lf/day)
Recent Project – Sundrop Energy

5 Soil Borings to 100 ft (500 lf)  
6 days to complete (83 lf/day)

5 CPT to 100 ft & 7 SCPT to 100 ft (1,200 lf)  
4 days to complete (300 lf/day)
Status Quo

Commoditization & Low Bid Procurement

Ethical?
Geotechnical Engineers and Deep Foundations

Please provide your opinions related to your experience with geotechnical engineers and their work product as it relates to deep foundation construction.

The information will be used to share with design and construction professionals. Your responses are anonymous. Your input is a valuable opportunity to improve our profession, and we appreciate your interest.

Next

Powered by SurveyMonkey
Check out our sample surveys and create your own now!
During construction, I rarely, if ever, encounter soil, rock and/or groundwater conditions that are significantly different from those expected.
During construction, I rarely, if ever, encounter soil, rock and/or groundwater conditions that are significantly different from those expected.
I find that inadequate use of technological innovation creates projects that require overdesign of deep foundations.
I find that inadequate use of technological innovation creates projects that require overdesign of deep foundations.
Based upon my own project experience, I believe that geotechnical engineers adequately maintain their ethical responsibility to hold paramount the safety, health and welfare of the public.
Based upon my own project experience, I believe that geotechnical engineers adequately maintain their ethical responsibility to hold paramount the safety, health and welfare of the public.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.
“My passion has been to build an enduring company whose people were motivated to make great products. Everything else was secondary. Sure it was great to make a profit, because that was what allowed you to make great products. But the products, not the profits were the motivation.”

$46.3 Billion Revenue
$13.1 Billion Profit
(28% of Revenue)

Inexplicable