PILE SETUP – LA-1
EXPERIENCE

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GEOTECHNICAL INVESTIGATION PROGRAM

• 102 CPT soundings
  – Depths from 100 feet to 200 feet
• 118 borings
  – Depths from 100 feet to 200 feet
• Exploration spacing
  – 400 feet
• 9 test piles at 4 locations during design
• 23 new CPT soundings and 7 load tests to be performed during construction
• Air boats were used for all explorations to minimize damage to the marsh
GAS POCKET & TOP DOWN CONSTRUCTION
LAI Pile Test Program
As of August 21, 2004 our LAI Pile Load Test Program has come to a successful conclusion.

Figure 1
Inspector monitoring data during one of the pile test loading sequences.

Center Photo
Boh Bros., pile test contractor, rigging the hydraulic jack to test concrete pile to 600 tons.

Figure 2
Rigging test pile with instrumentation prior to driving.
LOAD TEST PROGRAM

- **During Design**
  - 4 Locations
  - 9 Piles
  - Steel Pipe, Cylinder, and Square Concrete Piles

- **During Construction**
  - 7 Piles

- **Test Methods**
  - Static, Statnamic, Dynamic, EDC
<table>
<thead>
<tr>
<th>Test Location</th>
<th>Pile Type</th>
<th>Length (ft)</th>
<th>Hammer Type</th>
<th>Tip Elev. (ft)</th>
<th>Test Method</th>
<th>Setup Time (days)</th>
<th>Resistance (kips)</th>
<th>Splice</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-2</td>
<td>16&quot; PPC</td>
<td>130</td>
<td>Vulcan 010</td>
<td>-119.5</td>
<td>Dyn. &amp; Static</td>
<td>7</td>
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<tr>
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<td>54&quot; Cylinder</td>
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<td>Vulcan 040</td>
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<td>T-3</td>
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<td>Dyn. &amp; Static</td>
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<tr>
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<td>30&quot; Steel Pipe</td>
<td>195</td>
<td>Vulcan 020</td>
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<td>Dyn. &amp; Static</td>
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<td>1597</td>
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<td>160</td>
<td>Vulcan 040</td>
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<td>Dyn. &amp; Statnamic</td>
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<td>T-4</td>
<td>24&quot; PPC</td>
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<td>Vulcan 020/025</td>
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<td>Dyn. &amp; Static</td>
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<tr>
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<td>24&quot; PPC</td>
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<td>Vulcan 025</td>
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<td>Dyn. &amp; Static</td>
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<td>Vulcan 020/025</td>
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<td>Dyn. &amp; Static</td>
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<td>739</td>
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</tr>
<tr>
<td></td>
<td>24&quot; PPC</td>
<td>170</td>
<td>Vulcan 020/025</td>
<td>-134.0</td>
<td>Dyn. &amp; Static</td>
<td>6</td>
<td>769</td>
<td>yes</td>
</tr>
</tbody>
</table>
LOAD TEST PROCEDURES

• When can the pile be loaded and what load?

• Dynamic testing
  – Initial drive
  – 2, 4, 8, 24 hour, 2 days, 4 days, post static load test

• Static or Statnamic testing
  – 5 to 7 days after driving
SKOV-DENVER MODEL

\[
\frac{Q_t}{Q_0} = A \log\left(\frac{t}{t_0}\right) + 1
\]

\[t_0 = 1\text{day}\]
PILE SETUP

T-2 16-inch 109 Feet Penetration

\[
\frac{Q_s}{Q_0} = 0.4435 \log \left( \frac{t}{t_0} \right) + 1
\]

\[
R^2 = 0.9924
\]

\[
\frac{Q_t}{Q_0} = 0.4271 \log \left( \frac{t}{t_0} \right) + 1
\]

\[
R^2 = 0.9509
\]
PILE SETUP

T-2 54-inch 147 Feet Penetration

\[ \frac{Q_t}{Q_0} = 0.3205 \log\left(\frac{t}{t_0}\right) + 1 \]
\[ R^2 = 0.9865 \]

\[ \frac{Q_s}{Q_0} = 0.3511 \log\left(\frac{t}{t_0}\right) + 1 \]
\[ R^2 = 0.9413 \]
PILE SETUP
TEST LOCATION T-4
24-in 145-ft PENETRATION

\[ \frac{Q}{Q_{1s}} = 0.441 \log \left( \frac{t}{t_1} \right) + 1 \]
\[ R^2 = 0.9884 \]

\[ \frac{Q_t}{Q_{1t}} = 0.401 \log \left( \frac{t}{t_1} \right) + 1 \]
\[ R^2 = 0.9685 \]
PILE SETUP

TEST LOCATION T-4
24-in 195-ft PENETRATION - SPLICED

\[
\frac{Q_t}{Q_{1t}} = 0.222\log\left(\frac{t}{t_1}\right) + 1 \\
R^2 = 0.6457
\]

\[
\frac{Q_s}{Q_{1s}} = 0.137\log\left(\frac{t}{t_1}\right) + 1 \\
R^2 = 0.2543
\]

\[
\frac{Q_t}{Q_{1t}} = 0.259\log\left(\frac{t}{t_1}\right) + 1 \\
R^2 = 0.7885
\]

\[
\frac{Q_s}{Q_{1s}} = 0.222\log\left(\frac{t}{t_1}\right) + 1 \\
R^2 = 0.9842
\]

**Relative Resistance (Q/Q1day)**

**Elapsed Time (days)**

- **24-in PSC 194-ft Penetration - Total Resistance**
- **24-in PSC 194-ft Penetration - Skin Friction**
RESULT SUMMARY

• Range of $A = 0.30$ to $0.68$
• Average $A = 0.45$
• The results showed the test piles gained at least $65\%$ of $14$-day resistance in one day
Normalized Pile Resistance

Setup Time (days)

Relative Resistance

Max. Setup

Average Setup

Min. Setup

Max. Setup

Average Setup

Min. Setup
## Size Effect on Pile Setup (T-2)

<table>
<thead>
<tr>
<th>Pile Type</th>
<th>Setup Parameter (A)</th>
<th>Skin Friction</th>
<th>Total Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-inch PPC</td>
<td></td>
<td>0.44</td>
<td>0.43</td>
</tr>
<tr>
<td>54-inch Cylinder</td>
<td></td>
<td>0.35</td>
<td>0.32</td>
</tr>
</tbody>
</table>
## PILE TYPE EFFECT (T-3)

<table>
<thead>
<tr>
<th>Pile Type</th>
<th>Setup Parameter (A)</th>
<th>Skin Friction</th>
<th>Total Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-inch PPC</td>
<td></td>
<td>0.45</td>
<td>0.25</td>
</tr>
<tr>
<td>30-inch Steel Pipe</td>
<td></td>
<td>0.28</td>
<td>0.27</td>
</tr>
<tr>
<td>54-inch Cylinder</td>
<td></td>
<td>0.32</td>
<td>0.29</td>
</tr>
</tbody>
</table>
FINAL DESIGN

- 24-inch square concrete piles for all VECS bridges
- 24-hour restrikes are being used to verify the pile resistance
- Acceptance criterion: 65% of the nominal resistance at the 24-hour restrike
CONSTRUCTION AND ACTUAL PERFORMANCE

• 20- to 50-hour restrike on one pile each bent

• 194 bents has been completed as of last week

• 24-hour resistance
  – Range: 57% to 141% of the anticipated 14-day resistance
  – Average 74%
  – COV: 13%
ACTUAL RESULTS

Frequency

Resistance Ratio

0.6 0.65 0.7 0.75 0.8 0.85 0.9 0.95 1 1.05 1.1 1.15
OTHER INTERESTING RESULTS

![Graph showing resistance (kips) vs. pile location with skin friction, end bearing, and total resistance marked.](image-url)
Questions