COMBINED LOADING TESTS OF SCALE MODEL SPUDCAN FOOTINGS ON SOFT CLAY: EXPERIMENTAL DATA

by

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Combined Loading Tests of Scale Model Spudcan Footings on Soft Clay: Experimental Data

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Introduction
Presented here, in graphical form, are the results of 33 laboratory tests conducted with scale model "spudcan" type footings on soft Speswhite kaolin clay. This report is intended to supplement the D.Phil. thesis of Martin (1994); the thesis itself contains details of the testing equipment, soil properties and experimental procedures, together with a full analysis of the results.

Loads and Displacements
Vertical, horizontal and rotational displacements of the model footing are defined as follows:

Note that vertical displacement $z$ is defined by the embedment of the footing reference point below the original soil surface level, hence the use of the subscript RP. Vertical, horizontal and moment loads are defined with respect to a fixed frame of reference (i.e. one that is independent of footing rotation):
All of the load and displacement data contained in this report have been fully corrected for apparatus flexibility, etc. as described in Section 4.2.2 of Martin (1994). Moment load is divided by the footing radius $R$ to provide dimensional consistency with $V$ and $H$. Similarly, the rotation $\theta$ is multiplied by $R$ to give a displacement with dimensions of length.

**Standardised Presentation of Results**

Each clay sample was used for a number of separate displacement- or load-controlled footing experiments at different levels of embedment $z_{RP}$. Eleven batches of three kaolin samples were prepared; each test is identified by the letter "T" followed by two digits indicating the batch number (01 to 11), with a third digit to specify the sample number (1 to 3) within that batch. Thus T072 refers to the second clay sample of the seventh batch.

Each test record is laid out on two facing pages. The text block on the first page lists the significant events performed during the test and states the various displacement rates employed. The plot adjacent to the text block shows the measured variations of undrained clay strength $s_u$ and water content $w$ with depth below the soil surface. Each data marker in this plot represents an individual shear vane test or water content sample result; the solid and dashed lines are drawn through the respective averages at each measurement depth (60, 140, 220 and 300 mm). The remaining graphs on the first page of each test record show the variation of the three loads $V$, $H$, $M/R$ and the three displacements $z_{RP}$, $h$ and $R\theta$ with time.

The second (right hand) page contains 13 of the 15 possible load:load, load:displacement and displacement:displacement plots for the test; only $H:z_{RP}$ and $M/R:z_{RP}$ are excluded. At the upper left of this page there is an illustration of the model spudcan footing used in the test. Finally at the lower left of the page there is a text block stating the rate of data logging, the number of data points from which each plot is derived, and the maximum tensile vertical load registered during withdrawal of the footing at the completion of the test.

The two-page record is intended to provide information about the sequence of events in each footing test and a broad overview of the results obtained. For a detailed explanation of the tests performed, with analysis of the significant events in each, see Martin (1994).

**Reference**

Test No. T011 (Trial Test)
- 5 pure $h$ cycles [$\omega = 0^\circ$] at constant $z$, starting from high $V/V_0$.
- 4 vertical unload-reload loops [to $V/V_0 = 0$].

| $h$ cycles | $z_{up} = 0, 50, 100, 150, 200$ mm |
| vertical unload-reload loops | $z_{up} = 25, 75, 125, 175$ mm |

Displacement rates: $\dot{h} = \pm 0.083$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 12000 scans.
3. Maximum tensile load during footig retract'n: $V = -755.6 \text{ N}$ (at $z_{fr} = 187.4 \text{ mm}$).
Test No. T012 (Trial Test)
- 6 pure $\theta$ cycles [$\omega = 90^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>$\theta$ cycles</th>
<th>$z_{RP} = 0, 25, 50, 100, 150, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 75, 125, 175$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $R\dot{\theta} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T012
100 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.

3. Maximum tensile load during footing retract’n: $V = -699.6$ N (at $z_{RP} = 186.0$ mm).
Test No. T013 (Trial Test)

- 6 pure $h$ cycles [$\theta = 0^\circ$] at constant $z$, starting from low $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>$h$ cycles</th>
<th>$z_{RP} = 0, 25, 50, 100, 130, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 75, 125, 175$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.

3. Maximum tensile load during footing retraction: $V = -638.3$ N (at $z_{RP} = 174.4$ mm).
Test No. T021

- 5 pure 0 cycles [\( \omega = 90^\circ \)] at constant \( z \), starting from low \( V/V_0 \).
- 3 vertical unload-reload loops [to \( V/V_0 = 0 \)].

<table>
<thead>
<tr>
<th>0 cycles</th>
<th>( z_{RP} ) = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>( z_{RP} ) = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: \( R\dot{u} = \pm 0.167 \) mm/s; \( \dot{z} = +0.333 \) mm/s (vertical penetration), \(-0.167 \) mm/s (vertical unloading), \(-0.333 \) mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.

3. Maximum tensile load during footing retraction: \( V = -913.3 \, \text{N} \) (at \( z_{RP} = 174.0 \, \text{mm} \)).
Test No. T022

- 5 pure θ cycles [θ = 90°] at constant z, starting from high V/V₀.
- 3 vertical unload-reload loops [to V/V₀ = 0].

<table>
<thead>
<tr>
<th>θ cycles</th>
<th>zₜₚ = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>zₜₚ = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: \( \dot{z} = \pm 0.167 \text{ mm/s; } \dot{z} = \pm 0.333 \text{ mm/s} \) (vertical penetration), \(-0.167 \text{ mm/s} \) (vertical unloading), \(-0.333 \text{ mm/s} \) (footing extraction at end of test).
Test No. T022
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.
3. Maximum tensile load during footing retract'n: $V = -966.5$ N (at $z_{RP} = 168.5$ mm).
Test No. T023

- 5 pure $h$ cycles [$\omega = 0^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>$h$ cycles</th>
<th>$z_{SP}$ = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{SP}$ = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T023
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.
3. Maximum tensile load during footing retraction: $V = -918.2$ N (at $z_{RP} = 173.0$ mm).
Test No. T031

- 5 combined $h$ cycles [$\theta = 45^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $k$ cycles</th>
<th>$z_{ap}$ = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{ap}$ = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.118$ mm/s; $\dot{R} = \pm 0.118$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T031
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.
3. Maximum tensile load during footing retract’n: $V = -1052.5$ N (at $z_{pp} = 171.6$ mm).
Test No. T032

- 5 combined $h$:0 cycles [$\alpha = 135^\circ$] at constant $z$,
  starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $h$:0 cycles</th>
<th>$z_{zp} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{zp} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.118$ mm/s; $R\dot{h} = \pm 0.118$ mm/s;
$\dot{z} = +0.33$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.33$ mm/s (footing extraction at end of test).
Test No. T032
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.
3. Maximum tensile load during footing retraction: $V = -867.1$ N (at $z_{RP} = 153.0$ mm).
Test No. T033

- 5 combined $h: \theta$ cycles [$\theta = 157.5^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops to $V/V_0 = 0$.

<table>
<thead>
<tr>
<th>combined $h: \theta$ cycles</th>
<th>$z_{RP} = 0, 20, 50, 100, 200 \text{ mm}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150 \text{ mm}$</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.154 \text{ mm/s}$; $\dot{R} = \pm 0.064 \text{ mm/s}$; $\dot{z} = \pm 0.333 \text{ mm/s}$ (vertical penetration), $-0.167 \text{ mm/s}$ (vertical unloading), $-0.333 \text{ mm/s}$ (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retraction: $V = -871.7$ N (at $z_{RP} = 150.1$ mm).
Test No. T041 (repeat of T023)

- 5 pure $h$ cycles [$\omega = 0^\circ$] at constant $z$, starting from high $V/V'_0$.
- 3 vertical unload-reload loops [to $V/V'_0 = 0$].

<table>
<thead>
<tr>
<th>$h$ cycles</th>
<th>$z_{RP} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = +0.167$ mm/s; $\dot{z} = +0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T041
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.
3. Maximum tensile load during footing retraction: $V = -938.5$ N (at $z_{RP} = 164.4$ mm).
Test No. T042

- 5 combined $h$:0 cycles [$\omega = 112.5^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $h$:0 cycles</th>
<th>$z_{ap} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{ap} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.064$ mm/s; $\dot{z} = \pm 0.154$ mm/s;
$\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (fooing extraction at end of test).
Test No. T042
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.
3. Maximum tensile load during footing retract’n: $V = -910.4$ N (at $z_{RP} = 170.1$ mm).
Test No. T043 (repeat of T022)

- 5 pure $\theta$ cycles [$\omega = 90^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>$\theta$ cycles</th>
<th>$z_{RP} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $R\dot{\theta} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s
(v vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).

![Graph of Test No. T043](image)
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retract’n: $V = -1085.8$ N (at $z_{RP} = 161.9$ mm).
Test No. **T051** (repeat of T021)

- 5 pure 0 cycles \( [\omega = 90^\circ] \) at constant \( z \), starting from low \( V/V_0 \).
- 3 vertical unload-reload loops \([to V/V_0 = 0]\).

<table>
<thead>
<tr>
<th></th>
<th>( z_{zp} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 cycles</td>
<td>0, 20, 50, 100, 200 mm</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td>35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: \( \dot{R} = \pm 0.167 \text{ mm/s}; \dot{z} = \pm 0.333 \text{ mm/s} \) (vertical penetration), \(-0.167 \text{ mm/s} \) (vertical unloading), \(-0.333 \text{ mm/s} \) (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retract'n: $V = -923.0$ N (at $x_{RP} = 169.1$ mm).
Test No. T052

- 5 pure $h$ cycles [$\omega = 0^\circ$] at constant $z$, starting from low $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>$h$ cycles</th>
<th>$z_{RP} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T052
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retract'n: $V = -898.6$ N (at $z_{RP} = 160.7$ mm).
Test No. T053

- 5 combined $h: \theta$ cycles [$\theta_0 = 45^\circ$] at constant $z$, starting from low $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $h: \theta$ cycles</th>
<th>$z_{ap} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{ap} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.118$ mm/s; $\dot{\theta} = \pm 0.118$ mm/s;
$\dot{z} = 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s ( footing extraction at end of test).
Test No. T053
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.
3. Maximum tensile load during footing retraction: \( V = -972.7 \text{ N} \) (at \( z_{RP} = 159.9 \text{ mm} \)).
Test No. T061

- 5 combined \( h: \theta \) cycles \( [\omega = 135^\circ] \) at constant \( z \), starting from low \( V/V_0 \).
- 3 vertical unload-reload loops \([V/V_0 = 0] \).

<table>
<thead>
<tr>
<th>combined ( h: \theta ) cycles</th>
<th>( z_{RP} = 0, 26, 50, 100, 200 ) mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>( z_{RP} = 35, 75, 150 ) mm</td>
</tr>
</tbody>
</table>

Displacement rates: \( \dot{h} = \pm 0.118 \) mm/s; \( \dot{\theta} = \pm 0.118 \) mm/s; 
\( \dot{z} = 0.333 \) mm/s (vertical penetration), \( -0.167 \) mm/s (vertical unloading), \( -0.333 \) mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retract’n: $V = -910.5$ N (at $z_{RP} = 143.7$ mm).
Test No. T062

- 5 combined $h:θ$ cycles [$θ = 112.5°$] at constant $z$, starting from low $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $h:θ$ cycles</th>
<th>$z_{zp}$ = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{zp}$ = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $h = ±0.064$ mm/s; $Rθ = ±0.154$ mm/s; $z = ±0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 7000 scans.

3. Maximum tensile load during footing retract’n: $V = -939.6$ N (at $z_{RP} = 160.6$ mm).
Test No. T063

- 5 combined $h:\theta$ cycles [$\theta_0 = 157.5^\circ$] at constant $z$, starting from low $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>combined $h:\theta$ cycles</th>
<th>$z_{RF} = 0, 20, 50, 100, 200 \text{ mm}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150 \text{ mm}$</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.154 \text{ mm/s}; \dot{\theta} = \pm 0.064 \text{ mm/s};$
$\dot{z} = \pm 0.333 \text{ mm/s (vertical penetration)}, -0.167 \text{ mm/s (vertical unloading)}, -0.333 \text{ mm/s (footing extraction at end of test)}$. 

[Graphs and diagrams showing various measurements over time, including force (V), moment (M/R), depth (z), and water content (w%).]
Test No. T063
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 8000 scans.

3. Maximum tensile load during footing retract’n: \( V = -838.4 \text{ N} \) (at \( z_{RP} = 164.9 \text{ mm} \)).
Test No. T071

- 5 anticlockwise $h$:$\theta$ loops [$h$ leading] at constant $V$, with $V/V_0 = 0.4$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.5$].

<table>
<thead>
<tr>
<th>Type 1: $h$:$\theta$ loops ($\phi$)</th>
<th>$z_{RP} = 0, 50, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 5: $h$:$\theta$ loops ($\phi$)</td>
<td>$z_{RP} = 20, 100$ mm</td>
</tr>
<tr>
<td>Vertical unload-reload loops</td>
<td>$z_{RP} = 35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Loop data: $\dot{h}_{max} = \pm 0.167$ mm/s; $\dot{R}_{max} = \pm 0.167$ mm/s; loop period = 120 s. For details see Martin (1994), Section 4.5. Vertical displacement rates $\dot{z}$ - standard, as per previous tests.
Test No. T071
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 14000 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T072

- 5 clockwise \( h: \theta \) loops [\( h \) leading] at constant \( V \), with \( V/V_0 = 0.4 \).
- 3 vertical unload-reload loops [to \( V/V_0 = 0.5 \)].

<table>
<thead>
<tr>
<th>Type</th>
<th>( z_{RP} ) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 3</td>
<td>0, 50, 200 mm</td>
</tr>
<tr>
<td>Type 7</td>
<td>20, 100 mm</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td>35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Loop data: \( \dot{h}_{\text{max}} = \pm 0.167 \text{ mm/s}; \dot{\theta}_{\text{max}} = \pm 0.167 \text{ mm/s}; \) loop period = 120 s. For details see Martin (1994), Section 4.5.

Vertical displacement rates \( \dot{z} \) standard, as per previous tests.
Test No. T072
125 mm diameter model spudcan

NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 13580 scans.

3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T073

- 5 anticlockwise & clockwise h:θ loops [θ leading] at constant V, with $V/V_0 = 0.4$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.5$].

<table>
<thead>
<tr>
<th>Type</th>
<th>Loops</th>
<th>$z_{RP}$ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 4, 8, 4 loops ($\phi, \phi, \phi$)</td>
<td></td>
<td>$z_{RP} = 0, 50, 200 \text{ mm}$</td>
</tr>
<tr>
<td>Type 2, 6 loops ($\phi, \phi$)</td>
<td></td>
<td>$z_{RP} = 20, 100 \text{ mm}$</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td></td>
<td>$z_{RP} = 35, 75, 150 \text{ mm}$</td>
</tr>
</tbody>
</table>

Loop data: $R_0^{\max} = \pm 0.167 \text{ mm/s}$; $h_0^{\max} = \pm 0.167 \text{ mm/s}$; loop period = 120 sec. For details see Martin (1994), Section 4.5.

Vertical displacement rates $\dot{z}$ - standard, as per previous tests.
Test No. T073
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 13052 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T081

- 5 pure $h$ cycles [$\phi = 0^\circ$] at constant $V$, with $V/V_0 = 0.75$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.25$].

| $h$ cycles | $z_{RP} = 0, 20, 50, 100, 200$ mm |
| vertical unload-reload loops | $z_{RP} = 35, 75, 150$ mm |

Displacement rates: $\dot{h} = \pm 0.167$ mm/s; $\dot{z} = \pm 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T081
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 12752 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T082

- 5 pure 0 cycles [$\omega = 90^\circ$] at constant $V$, with $V/V_0 = 0.75$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.25$].

<table>
<thead>
<tr>
<th>Type</th>
<th>$z_{RP}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$ cycles</td>
<td>0, 20, 50, 100, 200 mm</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td>35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{R} = \pm 0.167$ mm/s; $\dot{z} = +0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 13028 scans.

3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T083

- 5 combined $h:0$ cycles [$\omega = 45^\circ$] at constant $V$; with $V/V_0 = 0.75$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.25$].

<table>
<thead>
<tr>
<th>combined $h:0$ cycles</th>
<th>$z_{RP} =$ 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} =$ 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.118$ mm/s; $\dot{R} = \pm 0.118$ mm/s;
$\dot{z} = +0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T083
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 12760 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T091

- 5 pure $h$ cycles [$\omega = 0^\circ$] at constant $V$, with $V/V_0 = 0.2$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.75$].

| $h$ cycles | $z_{zp} = 0, 20, 50, 100, 200$ mm |
| vertical unload-reload loops | $z_{zp} = 35, 75, 150$ mm |

Displacement rates: $\dot{h} = \pm 0.167$ mm/s; $\dot{z} = \mp 0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
Test No. T091
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 13192 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T092

- 5 pure θ cycles [ω = 90°] at constant V, with V/V₀ = 0.2.
- 3 vertical unload-reload loops [to V/V₀ = 0.75].

<table>
<thead>
<tr>
<th>θ cycles</th>
<th>z_{RP} = 0, 20, 50, 100, 200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>z_{RP} = 35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: R\(\dot{\theta}\) = ±0.167 mm/s; \(\dot{z}\) = ±0.333 mm/s (vertical penetration), −0.167 mm/s (vertical unloading), −0.333 mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 13264 scans.

3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T093

- 5 combined \( h:0 \) cycles \([\omega = 45^\circ, 157.5^\circ]\) at constant \( V \), with \( V/V_0 = 0.2 \).
- 3 vertical unload-reload loops [to \( V/V_0 = 0.75 \)].

\[
\begin{align*}
\text{\( h:0 \) cycles [\( \omega = 45^\circ \)]} & \quad z_{\text{ap}} = 0, 50, 200 \text{ mm} \\
\text{\( h:0 \) cycles [\( \omega = 157.5^\circ \)]} & \quad z_{\text{ap}} = 20, 100 \text{ mm} \\
\text{vertical unload-reload loops} & \quad z_{\text{ap}} = 35, 75, 150 \text{ mm}
\end{align*}
\]

Displacement rates: \( \dot{h} = \pm 0.118 \text{ mm/s} \); \( \dot{h} = \pm 0.118 \text{ mm/s} \) \([\omega = 45^\circ]\); \( \dot{h} = \mp 0.154 \text{ mm/s} \); \( \dot{h} = \pm 0.064 \text{ mm/s} \) \([\omega = 157.5^\circ]\).

\( \dot{z} \) - standard vertical displacement rates, as per previous tests.
Test No. T093
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 12000 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T101 (repeat of T081)

- 5 pure h cycles \([\alpha = 0^\circ]\) at constant \(V\), with \(V/V_0 = 0.75\).
- 3 vertical unload-reload loops [to \(V/V_0 = 0.25\)].

<table>
<thead>
<tr>
<th></th>
<th>(z_{RP})</th>
</tr>
</thead>
<tbody>
<tr>
<td>(h) cycles</td>
<td>0, 20, 50, 100, 200 mm</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td>35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: \(\dot{h} = \pm 0.167\) mm/s; \(\dot{z} = \pm 0.333\) mm/s (vertical penetration), \(-0.167\) mm/s (vertical unloading), \(-0.333\) mm/s (footing extraction at end of test).
Test No. T101
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 14800 scans.

3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T102 (repeat of T082)

- 5 pure 0 cycles \([\omega = 90^\circ]\) at constant \(V\) with \(V/V_0 = 0.75\).
- 3 vertical unload-reload loops [to \(V/V_0 = 0.25\)].

| Displacement rates: \(R\dot{\theta} = \pm 0.167 \text{ mm/s}; \dot{z} = +0.333 \text{ mm/s (vertical penetration), } -0.167 \text{ mm/s (vertical unloading), -0.333 mm/s (footing extraction at end of test).} \)
Test No. T102
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 15992 scans.
3. Maximum tensile load during footing retraction: not logged in this test.
Test No. T103

- 5 combined $h=0$ cycles [$\phi = 135^\circ$] at constant $V$, with $V/V_0 = 0.75$.
- 3 vertical unload-reload loops [to $V/V_0 = 0.25$].

<table>
<thead>
<tr>
<th>combined $h=0$ cycles</th>
<th>$z_{RP} = 0, 20, 50, 100, 200$ mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical unload-reload loops</td>
<td>$z_{RP} = 35.75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{h} = \pm 0.118$ mm/s; $\dot{z} = \pm 0.118$ mm/s;
$\dot{z} = +0.333$ mm/s (vertical penetration), $-0.167$ mm/s (vertical unloading), $-0.333$ mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 14000 scans.

3. Maximum tensile load during footing retraction: $V = -883.0$ N (at $z_{RP} = 166.6$ mm).
Test No. T111 (4 times slower than standard)

- 5 pure $\theta$ and pure $h$ cycles [$\omega = 90^\circ$, $0^\circ$] at constant $z$,
  starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>Type</th>
<th>$z_{RP}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$ cycles</td>
<td>0, 50, 200 mm</td>
</tr>
<tr>
<td>$h$ cycles</td>
<td>20, 100 mm</td>
</tr>
<tr>
<td>Vertical unload-reload loops</td>
<td>35, 75, 150 mm</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{R} = \pm 0.042$ mm/s; $\dot{h} = \pm 0.042$ mm/s;
$\dot{z} = +0.083$ mm/s (vertical penetration), $-0.042$ mm/s (vertical unloading), $-0.083$ mm/s (footing extraction at end of test).
Test No. T111
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 2 complete scans (of all channels) per sec. Data plotted from 11688 scans.

3. Maximum tensile load during footing retract'n: $V = -959.7$ N (at $z_{RF} = 165.6$ mm).
Test No. T112 (16 times slower than standard)

- 5 pure 0 and pure h cycles [$\omega = 90^\circ$, $0^\circ$] at constant $z$
  starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>Type</th>
<th>$z_{RP}$ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 cycles</td>
<td>0, 50, 200</td>
</tr>
<tr>
<td>h cycles</td>
<td>20, 100</td>
</tr>
<tr>
<td>vertical unload-reload loops</td>
<td>35, 75, 150</td>
</tr>
</tbody>
</table>

Displacement rates: $\dot{R} = \pm 0.010$ mm/s; $\dot{h} = \pm 0.010$ mm/s; $\dot{z} = \pm 0.021$ mm/s (vertical penetration), $-0.010$ mm/s (vertical unloading), $-0.021$ mm/s (footing extraction at end of test).
NOTES

1. For load and displacement definitions and sign conventions, see the start of this report.

2. Logging frequency: 1 complete scan (of all channels) every 2 s. Data plotted from 10939 scans.

3. Maximum tensile load during footing retraction: $V = -720.3$ N (at $z_{\text{FP}} = 170.1$ mm).
Test No. T113 (2 times faster than standard)

- 5 pure $\theta$ and pure $h$ cycles [$\omega = 90^\circ$, $0^\circ$] at constant $z$, starting from high $V/V_0$.
- 3 vertical unload-reload loops [to $V/V_0 = 0$].

<table>
<thead>
<tr>
<th>Type</th>
<th>$z_{RP}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta$ cycles</td>
<td>$0.50, 200$ mm</td>
</tr>
<tr>
<td>$h$ cycles</td>
<td>$20, 100$ mm</td>
</tr>
<tr>
<td>Vertical unload-reload loops</td>
<td>$35, 75, 150$ mm</td>
</tr>
</tbody>
</table>

Displacement rates: $R\dot{\theta} = \pm 0.333$ mm/s; $h = \pm 0.333$ mm/s;
$\dot{\bar{z}} = \pm 0.667$ mm/s (vertical penetration), $\pm 0.333$ mm/s (vertical unloading), $-0.667$ mm/s (footing extraction at end of test).
Test No. T113
125 mm diameter model spudcan

NOTES
1. For load and displacement definitions and sign conventions, see the start of this report.
2. Logging frequency: 4 complete scans (of all channels) per sec. Data plotted from 4000 scans.
3. Maximum tensile load during footing retraction: $V = -954.9$ N (at $z_{RP} = 166.2$ mm).