Cast-in-situ Tubular Piles (CTP)

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Single CTP Construction

(1) Positioning casing; (2) Driving casing; (3) Placing steel and pouring concrete; (4) Connecting hammer; (5) Extracting casing; (6) Completion of extracting.
CTP Working principles

- 1-Outer tube
- 2-Inner tube
- 3-Barrel core space
- 9-Male connector
- 10-Female connector

- O.D. = 3.3 ~ 6.6 ft (1000~2000 mm)
- T = 4.72 ~ 7.87 in (120~200 mm)
Continuous Wall Construction
Protection Levee
Protection Levee
Protection Levee
Excavation Support
Excavation Support
Railway Embankment
Advantages

- Large diameter
- Consistent, high quality concrete
- High axial capacity
- Fast construction
Advantages

- Excellent lateral load resistance
- Composite foundation
- Minimum post-construction settlement (No preloading is needed)
- Effective in soft soil deposits (clay or sand) (Liquefaction mitigation)
Environmental Advantages

- Small ground vibration (compared to pile driving)
- Low noise (compared to pile driving)
- No or little soil spoils (compared to drilled shafts)
- Small concrete volume (less carbon footprint)
Axial Geotechnical Resistance (Compression)

\[ Q_{uk} = \xi_1 Q_{SK} + \xi_2 Q_{PK} + \xi_3 Q_{PSK} \]

- \( Q_{uk} \) total resistance
- \( \xi_1 Q_{SK} \) shaft resistance
- \( \xi_2 Q_{SK} \) tip resistance on pile wall
- \( \xi_3 Q_{PSK} \) tip resistance soil plug
Vertical load-settlement predictions using SHAFT program

\[ f_{sn} = \alpha (S_u)_s \]

\( \alpha \) is shown in Figure.

\[ f_{sb} = 0.83N_c^* (S_u)_b \]

\( N_c^* \) is given by SHAFT \( (N_c^* = 6.5 - 9.0) \)
Vertical load test results and SHAFT program predictions

<table>
<thead>
<tr>
<th>Vertical load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (m)</td>
</tr>
<tr>
<td>Mud Clay</td>
</tr>
<tr>
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</tr>
<tr>
<td>Silty Clay</td>
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<tr>
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</tr>
</tbody>
</table>

$D_{out}=1.0$ m
$t=0.12$ m
$E_p=22$ GPa

Pile head load, $Q$ (kN)

Settlement, $s$ (mm)

Filed test result of Shanghai case
Calculated result of Shanghai case

Case_1: Shanghai North Central Expressway
Vertical load test results and SHAFT program predictions

Case_2: Jiyi Road, Nanjing, China
Lateral load-deflection predictions using LPILE program

\[
E_{\text{combined}} = \frac{E_c A_c + E_s A_s}{A_c + A_s}
\]

\[
A_{\text{combined}} = A_c + A_s = \frac{\pi D_{\text{out}}^2}{4}
\]
### Lateral load test results and LPILE program predictions

#### Case_3: Hang-Qian Expressway, China

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Thickness (m)</th>
<th>Unit weight (kN/m²)</th>
<th>Lateral load</th>
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</thead>
<tbody>
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<td>0</td>
<td>100</td>
<td>Lateral load</td>
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</tbody>
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<table>
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<tr>
<th>Depth (m)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>100</td>
<td>Lateral load</td>
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<tbody>
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<tbody>
<tr>
<td>0</td>
<td>15</td>
<td>100</td>
<td>Lateral load</td>
</tr>
</tbody>
</table>

### Undrained confined strength, $S_u$ (kPa)

- **Silty Clay**: 1.6 kPa
- **Mud Clay**: 3.85 kPa
- **Clay**: 4.8 kPa
- **Silty Clay**: 1.3 kPa

### Static lateral load, $H_0$ (kN)

- **Filed test result**: 1.6 kPa
- **LPILE calculation result**: 8.7 kPa
Lateral load test results and LPILE program predictions

<table>
<thead>
<tr>
<th>Thickness (m)</th>
<th>Unit weight (kN/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>0.5</td>
</tr>
<tr>
<td>17.64</td>
<td></td>
</tr>
<tr>
<td>Mud</td>
<td>21.5</td>
</tr>
<tr>
<td>17.15</td>
<td></td>
</tr>
<tr>
<td>Mud</td>
<td>10.0</td>
</tr>
<tr>
<td>17.15</td>
<td></td>
</tr>
</tbody>
</table>

Undrained confined strength, $S_u$ (kPa)

Cyclic lateral load, $H_0$ (kN)

Deflection, $y_0$ (mm)

Field test result

LPILE calculation result

Case_4: Xuyang Road, Zhejiang, China
Thank You