SRT Plate Piles Stabilize Highway Embankments

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Region Enginee
SRT Plate Piles

- Galvanized Steel, or Black Steel (+ 1/8 inch for corrosive conditions)
- Steel sections: Angles, S-Shape
- Lengths vary from 6 to 16 feet
SRT Plate Piles

Unstable Layer

Competent Layer

Slope increment supported by SRT Plate Pile
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCS</td>
<td>CH</td>
</tr>
<tr>
<td>PI (%)</td>
<td>42</td>
</tr>
<tr>
<td>Satd. moisture content</td>
<td>30%</td>
</tr>
<tr>
<td>Optimum dry density</td>
<td>104.5 pcf</td>
</tr>
<tr>
<td>Peak friction angle</td>
<td>27 deg</td>
</tr>
<tr>
<td>Peak Cohesion</td>
<td>250 psf</td>
</tr>
<tr>
<td>Residual friction angle</td>
<td>26 deg</td>
</tr>
<tr>
<td>Residual cohesion</td>
<td>100 psf</td>
</tr>
</tbody>
</table>

(Short, R., Collins, B.D., Bray, J.D., and Sitar, N., 2005)
Unreinforced Slope
Failure 7 minutes after water injection
Reinforced Slope
Re-saturated slope after 6 months of summer drying
Case History #1: Caltrans Hwy. 5 and Route 20

**Project:** CalTrans Hwy. 5 and Route 20 Interchange  
**Key Issues:** Slope creep and shallow slides along 1.5 miles roadway

![Diagram showing pavement edge cracking, expansive clay fill, and shoulder displacement due to slope creep and shallow slides.](image-url)
Case History #1: Caltrans Hwy. 5 and Route 20

SRT DESIGN

- 9,000 Plate Piles in 70 days
- 6- and 10-ft lengths
- $3,000,000 cost SAVINGS
Case History #1: Caltrans Hwy. 5 and Route 20

No issues 5 years later!
Perform stability analysis of unreinforced slope:
- Verify material property values, and
- Evaluate depth of sliding
Design of Plate Piles

- Case histories and numerical analyses at University of Missouri (Loehr and Brown, 2008, Joint ADSC/DFI Micropile report)

- Full-scale tests of laterally loaded piles at Iowa State (White et al., 2008, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 134, No. 4)

LPILE (ENSOFT/University of Texas)
The shear force at the sliding depth is considered to be the \textit{mobilized resistance} for that sliding depth. (Loehr and Brown, 2007; Sabatini et al., 2005)

For example,

\[ V = 2877 \text{ lbs} = 2.8 \text{ kips} \]

\[ V_{\text{ult}} = F_y \cdot A = (50 \text{ ksi})(1.66 \text{ in}^2) = 83 \text{ kips} \]
Design of Plate Piles

Structural capacity of the S-shape is not a limit state

\[ M_{\text{max}} = 36.6 \text{ in-kips} \]

\[ M_{\text{ult}} = F_y \cdot S = (50 \text{ ksi})(1.67 \text{ in}^3) = 83.5 \text{ in-kips} \]
Design of Plate Piles
Case History #2: VDOT I-495 HOT Lanes

**Project:** VDOT I-495 HOT Lanes

**Key Issues:** Restricted Access; low FS

- Constructed embankments did not meet required FS
- VDOT required vigorous review of SRT design. It was approved!
Case History #2: VDOT I-495 HOT Lanes
Case History #3: NCDOT Western Wake Expressway

**Project:** NCDOT Western Wake Expressway  
**Key Issues:** Expedited fix

- Slope below a sound barrier wall experienced failure
- 3H:1V slope; translational failure along clay-lined bedding planes
Case History #3: NCDOT Western Wake Expressway

- 10 ft Black Steel Plate Piles
- No major earthwork required
- Slope track-rolled; pile positions marked
- Install on slope!
Questions?