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Session 6: Case Histories

Full Scale Field Test on Single Micropiles and Networks of Micropiles of Titan and Expander Body Types

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Summary

- Full scale field test funded by U.S. Military, installed and tested by Structural Preservation Systems, Inc. (SPS) in Baltimore, MD, and designed and analyzed by Geosystems, L.P.
- Bulk of test used a total of 28 "self-drilling" Titan Ischebeck micropiles, installed in 6 groups/networks, plus 6 individual vertical "baseline" Titan micropiles.
- 4 individual Expander Body micropiles also installed vertically for comparison in same soils.
- Typically in medium/dense, medium/fine sand.
- Lateral and tensile testing of groups/networks. Tensile testing only of vertical elements.

Summary (Continued)

- Titans (30/16) shown in Table 1, Figures 1, 3, and 4, and Photos 7 and 8.
- Expander Bodies as per Table 4.
- Network load testing as per Figure 10, Photos 11 and 12, and Table 5.
- Individual Titans in sand averaged 1.7 to 2.6 kips/ft (21 to 27 psi). Expander Bodies as per Page 36 (could not fail EB 308 at tendon yield).
- Titan network lateral data shown in Table 9 and Figure 11.
- Titan network tensile loading as in Tables 10 and 11.
- Summary of performance data – Section 7.2.

Table 1. Details of pile group composition.

GROUP	NO. OF BARS IN EACH GROUP	NOTE
AV	2	Vertical, 2 feet apart, 9 feet long
AR	2	Inclined out at 25°, 2 feet apart at surface; 9 feet long
BV	4	Vertical at 90° round 2-foot diameter circle; 9 feet long
BR	4	Inclined out at 25°, round 2-foot diameter circle; 9 feet long
CV	8	Vertical at 45° spacing, round 2-foot diameter circle; 9 feet long
CR	8	Inclined out at 25°, at 45° spacing around a 2-foot diameter circle; 9 feet long

7.2 Summary of Performance Data

- Ultimate bond values for individual vertical Titans in sand ranged from 1.72 t 2.63 kips/ft (average 2.2 kips/ft). (21 to 2 psi: average 24 psi). For the two shortest piles in clayey fill with no other overburden cover, the values were severa times lower.

- The two small Soilex EB anchors (28 to 3 cm diameter) could not be failed at tendor yield (about 43 kips), with depths of cove from 4 to 9 feet. The two larger bodies (3 to 42 cm diameter) experienced pull out a loads of 81 to 103 kips with cover of 6 ft 8 in and 7 ft 9 in respectively. The tests confirmed that, inter al., the ultimate capacity in these soils was directly proportional to the cross sectional area of the inflated EB.

7.2 Summary of Performance Data (continued)

- Each pile cap was subjected to three or five lateral load tests from different directions. In general:
  - A normalized group elastic stiffness ratio was calculated for each cap in each test.
  - The cap performance became generally "softer" progressively as successive tests were conducted.
  - Reticulated groups were stiffer than vertical groups, by 26% (2 piles), 100% (4 piles) and 300% (8 piles).
  - Oblique loading provided lower stiffness data.
  - Stiffness increased with the number of piles in the groups and with reticulation: the reticulated 8-pile group was over 12 times stiffer than the vertical 2-pile group.

7.2 Summary of Performance Data (continued)

- For group tensile loading, the 2-pile group and the reticulated 4-pile group performed in manners characteristic of the individual piles each acting independently (i.e., interfacial bond failure as in the case of the individual Titans). However, the vertical 4-pile group and two 8-pile groups failed as if the piles load created a continuous cylindrical failure surface allowing the whole group to be extracted at a lower load – consistent with the shear strength of the soil itself. These data argue for a certain minimum interpile spacing to be used to allow the piles to act independently.