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z7 April 2015

Re: Summary of Analyses of Helicast Screw Piles

The University of Sydney has been performing advanced numerical analyses of Helicast screw piles for the purpose of demonstrating their performance to support a submission to the Australian Standards committee responsible for the piling code AS 2159 -2009.

This work has focused on the performance of Helicast piles with flute sizes varying from 280mm to 450 mm in dense sand. Some analyses have been performed to look at the behaviour in stiff clay. The analyses have considered a range of stress levels, representative of burial depths of the Helicast screw section of between 2 and 10 m. The results have shown that the pile response of the different sized flutes is similar and a reasonably unique response (normalized by stress level) can be obtained for a particular set of soil parameters.

Further analyses were performed in which the soil properties of the sand were varied to model changes in the sand relative density. These analyses have shown that the response is sensitive to variations in sand density.

In a separate exercise projects have been performed at the University of Sydney in which students have tested single helical plates in dense sand and performed analyses similar to those conducted for the Helicast piles. The results of these small scale laboratory experiments have been reasonably reproduced by the numerical analyses.

From the work performed to date we have developed a capacity to analyse and model helical screw piles. However, several simplifications have been required. The most significant being that the helical section has had to be modelled as a series of flat disks as the numerical analysis could not handle the true 3-D geometry, the analysis has used a relatively simple "Mohr-Coulomb" model for the sand, and the installation process has not been modelled (it has been assumed that the piles are "wished in-place" and the stresses around the pile are uniform throughout the analysed region).

It is believed that the installation of a Helicast multi turn helix in dense sand creates a bulb of increased lateral stress around the helical section. To model this effect analyses have been performed in which the soil has a uniformly higher lateral stress. These analyses show that the higher lateral stress can increase the pile resistance by a factor of 1.75. Confirmation of this multiplier factor by site tests in dense sand is required.

Because of the simplifications made in the analyses and the limited field data available, additional experimental data are required to confirm that the behaviour is reasonably predicted by the results of the numerical analyses. These data are required to establish the important link between standard CPT site investigation data and the pile performance. Data from several dense sand sites covering a range of relative densities should be considered. These data should be complemented by additional small scale laboratory tests of the helicast anchors to demonstrate the effect of lateral stress changes during installation.

It is anticipated that once several site tests are conducted, a validated multi-turn screw pile design formula will be determined incorporating, helix size, pile shaft size, length of pile, and standard site investigation data from cone penetration (CPT) or equivalent tests. This would enable any practicing engineer to design a multi turn helix screw pile using the Helicast range.

A handwritten signature in black ink, appearing to read "David Airey". The signature is fluid and cursive, with a large loop at the end of the last name.