BESTBASE
FOUNDATION SYSTEMS

[WHITE PAPER]

The Use of Helical Anchors in Problem Soils

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BACKGROUND

Helical anchor foundation systems evolved from a long history of application in soft and/or difficult soil conditions. Early on, “screw piles,” or “screw mandrills,” were often timbers fitted with an iron screw that was manually twisted into the ground -- similar to today’s wood screw. After advancement to the depth desired, they were then removed and replaced with a crude form of concrete. These conventional screw piles have been in use since the 18th Century, supporting waterfront areas and, as early as the 19th Century, soft soil conditions for bridge structures.

As use grew, power-installed anchors were developed, and in England in the 1800's, the first commercially feasible helical anchor utilized. The initial large-scale application occurred in the early 1900's in response to a need for a rapidly-installed guy wire anchor primarily for use in the electric power industry.

In the last 20 years, the use of helical anchors has expanded beyond the electrical power industry. Rapid installation, immediate loading capability, and resistance to both uplift and bearing loads have resulted in many new and different geotechnical applications. For example, helical anchors are now commonly used for tie-backs in retaining walls, and as a part of foundations for lightly loaded structures. Some of these include transmission line towers, light poles, tie-downs for manufactured housing, and temporary structures for the underpinning of lightly loaded single-family dwellings.

In addition, helical anchors have been successfully used to resist expansive soils, and are easily installed without casings through groundwater subsurface flow conditions and caving soils. Finally, specialty use applications for heavy duty anchors have been manufactured for sustained loadings in excess of 100,000 lbs.

TODAY?S HELICAL ANCHORS

Compared to common footings, drilled piers, and driven pile foundations, some of the benefits of today's helix anchors include:

- Variable load design capacity with helix and depth modification
- Ability to be removed for temporary applications
- Ease of transportation to limited access and/or remote sites
- Ease in capacity determinations through installation-torque correlations
- Ability to be installed without casing for groundwater inflows and in caving soils
- Speed of installation when compared to other deep foundations
- Ability to be installed at superior angle for added lateral resistance
- Ease of access with smaller equipment in otherwise inaccessible areas
- Low noise and/or minimal vibration installation
- Galvanized or epoxy-coated for corrosion resistance; can be grouted in-place after installation
- Elimination of concrete form-stripping and debris removal
- No requirement for concrete set; immediately attached to structures
- No drilling spoils

ANCHORS IN AREAS OF HIGH SEISMIC ACTIVITY

While the response of helix piers to seismic loads has been adequately studied, there is anecdotal evidence suggesting helix pier foundations perform well in earthquakes. A recent study was made by a California engineer who revisited several helix pier supported structures to quantitatively assess their performance during the 1994 Northridge earthquake. It was found that helix pier-supported structures performed better than those on other foundations (Perko and Rupiper, 2000).

DESIGN AND INSTALLATION OF THE MODERN ANCHOR

Modern anchors are constructed of a helical-shaped circular steel plate(s), welded to a steel shaft. The circular plates are constructed at a carefully controlled pitch. The helical anchor is advanced at a controlled rate, typically using a hydraulic-powered auger system. Advancement is continued until the helix penetrates into soil strata of suitable strength and/or the required installation torque is achieved. The field use of installation torque determination provides an inherent quality control system for each anchor installed.

The installation procedure includes continuous monitoring and recording with an electrical constant readout device. The relationship between torque and anchor capacity allows for each anchor to be installed to the depth required to achieve its specified ultimate capacity. Therefore, correlation of installing torque to the anchor or pile capacity is used as an onsite quality control method similar to blow count determination for driven piles.

The current use of specialty manufactured helical anchors is very competitive in comparison with mid-range load capacity, especially in situations where driven piles or caissons have load capacities upwards of 150,000 lbs. This is particularly relevant when comparing the installation production as measured by the number of foundation elements installed per day.

SUMMARY

In summary, the helical system is far superior in the several situations outlined, and with the current practice of fuel capacity determination, the helical anchor will most likely become the accepted answer for problem soils, in addition to providing the obvious economic advantage in conventional foundation subsoil conditions.

REFERENCES

1| Perk, H. A. and Rupiper, S.J., 2000, “Helix Pier Engineering Handbook,” 2000: Ingal Precision Foundations, Inc.

2| Stephenson, R. W., March 6, 2002, “Helical Foundations and Tie-Backs,” State of Art: University of Missouri-Rolla