

## **Truth in Advertising** **by W. Tom Witherspoon, PhD, P.E.**

The following article deals with claims made by an engineer based in Colorado and a separate article that appeared in a publication representing the Helical Pier industry. It refers to a particular engineer's comments as well as more promotionally oriented information which appeared in a separate publication. While it is the opinion of Foundation Drilling Magazine that there are a variety of earth and rock anchor systems that have a proper place in the foundation and anchor contractor's tool box one should always be wary of unsubstantiated claims made by promoters and/or providers of a proprietary system. System performance claims should be based on hard research and apples-to-apples comparison rather than on promotional materials. The author of the following Contractors Viewpoint article has performed and published sound engineering research on the performance of a variety of support elements under the most rigorous professional engineering scrutiny. His PhD thesis entitled, <sup>3</sup>Load Capacity of Residential Underpinning in Expansive Clays<sup>2</sup> is available in CD format through the ADSC's Technical Library Service, catalog number FV46. (Editor)\*

We are accustomed to the genius of marketing and how this medium has transformed a nation into the envy of the world. May times we don't know we need a product until we see some clever advertising that makes us realize what we have is not as good as the new fangled product. Each election politicians make us realize, however, that we must investigate advertising to make sure the facts are accurate as actually presented. Our industry of foundation technology is no exception as evidenced by the diversity of competing products marketed to engineers, contractors and owners.

A recent article written by a Colorado engineer provided a comparison between drilled concrete piers and helical piers in the highly expansive soil of Colorado. The focus of the article was that if a drilled shaft was drilled 18' deep in clay soil with a 10' active zone (zone of seasonal moisture change) that the 8' embedment below the active zone would not resist uplift forces created along the shaft. Well duh! Who would install so short a pier and expect it to resist uplift? To make such a comparison is misleading because engineers would specify sufficient depth or underream the base to resist uplift. Either depth, bellling of the bottom or sufficient penetration into suitable rock strata will provide sufficient resistance to counter uplift of the shaft. No credible engineer would allow straight shafts in expansive soil without protection against the ravages of these tricky conditions.

The author of this article goes on to state that <sup>3</sup>installing pier reinforcement and placing concrete at greater depths would also become a problem<sup>2</sup>. Apparently this engineer has not reviewed the extensive ADSC library that addresses these issues. Millions of dollars in research has provided specifications for the drilled shaft that address these very issues. It is very important to provide adequate reinforcement to resist tensile forces created by the swelling along the shaft. In the expansive soil area of Las Colinas (Irving, Texas) for instance, it is quite common to provide vertical steel area, with respect to pier diameter, of 1.5% or more. Drilled shafts installed in this area are designed with sufficient vertical rebar area to address these extreme uplift forces.

Years of research on concrete placement has provided a template to address deep piers including mix design modifications and placement specifications. These specifications are not only available in the ADSC library but in the 1999 FHWA drilled shaft design manual (note\* this manual is currently being updated by Dr. John Turner and Dr. Dan Brown who are two of the most prominent pier and pile experts in the industry).

Another questionable statement by this author is that drilled concrete piers should only be used in moderately expansive clay and would not be perform adequately in highly expansive soils. The FHWA Drilled Shaft manual provides specifications that not only allow drilled shaft installation in expansive soils but because of these specifications drilled shafts are the most suitable underpinning method to address this environment.

A second article in a helical industry publication compared a drilled shaft project to a helical pier project in Fort Collins, Colorado. The focus of the article was how much faster the helical piers were installed than the drilled shafts on a comparable project. The article went on to say how the helical piers were cheaper than the drilled shafts, which saved interest on project funding, reduced project traffic, reduced project insurance, lower project management costs and improved workplace safety. This comparison is apples and oranges. The helicals will have much less axial capacity than a drilled shaft of comparable diameter and depth. Should speed of installation and a cheaper product be the determining factor in foundation design? In fact pictures from the follow up article show a heavy concrete structure supported by drilled shafts while the helical project appears to be a structural steel building.

There is also a very critical problem of settlement when installing the helical piers. As proven in my research conducted under the most rigorous engineering scrutiny at the University of Texas Arlington (UTA) Arlington, Texas, the helical piers will have a significant initial deflection before reaching ultimate load. This is a factor witnessed by this engineer and other practitioners when using helical piers for remedial underpinning. In fact, this engineer witnessed 1" to 3" deflection when installing helicals under one and two story house foundations in North Carolina in the mid 1990's. At each helical pier it was necessary to "seat" the anchor using the weight of the structure prior to making the final topographic adjustment in perimeter. Only then would the helical provide adequate support to support the foundation.

The UTA research showed inefficiency in screwing the helix into the ground, which indicates there is some auguring in lieu of the helix efficiently pulling the shaft into the ground. With inefficiency, there will be a void behind the leading edge of the helix where spoils provide compressible strata when load is applied. Therefore, there is some risk in usage of helical piers for new construction unless the design engineer allows for some differential settlement at the less efficient helical piers (copies of this research available through the ADSC library). This research also demonstrated that usage of a trailing helix will not increase the axial capacity in proportion to the area of the helix because of a disturbance factor, which lessens soil shear strength under the trailing helix. In fact, for this research the disturbance factor was so great that the contribution by the trailing helix was only 20% of the helix area with respect to soil shear strength at that depth. It was also interesting that axial capacity of the single and double helix showed very little difference.

We must remember that drilled shafts have been tested, researched and improved for decades. The helicals, however, have not had the scrutiny and independent research to establish specifications and quality control to measure up to the standard established by the drilled shafts. Research done at UTA was very important because it addressed helical performance in comparison with a comparable drilled shaft in very expansive clay and the results were eye opening. A 12" diameter x 15' deep straight shaft provided an average compression axial capacity of 110,610 pounds while the 12" diameter single helix and 10" x 12" diameter double helix provided an average of 26,676 pounds. The following chart says it all.

Drilled shafts are a premier foundation system but quality control is critical to their performance. Research is continuing and the new FHWA manual will be updated to reflect improvements that have been made in construction and design over the past 9 years. Drilled shafts are a science and as with any science, the system is constantly under scrutiny from marketers who want to sell their product. A comparison between the drilled shaft and helical pier based upon misleading uplift scenarios and how one project was so much faster and cheaper is, however, a disservice to the engineering community and could cause some engineers to make design changes based upon the wrong parameters.

**\*The opinions expressed in this article are those of the author and do not reflect any official position of either Foundation Drilling magazine or the ADSC: The International Association of Foundation Drilling. We welcome reader comment. (Editor)**