

DECEMBER 2013 MEETING

Wednesday, December 11, 2013 (1.5 PDH)

TECHNICAL PROGRAM

Design of Drilled Shafts in Expansive Soils. Part 2

Speakers: [Robert L. Lytton, Ph.D., P.E.](#) Professor of Civil Engineering at Texas A&M University, Bryan TX, Tel. No. 979-845-9964 and [Nicole Wylie, P.E.](#) of [Forensic Engineers Inc.](#), Houston TX, Tel. No. 713-468-8100.

Dr. Lytton is an Honorary FPA Life Member, FPA Structural Committee Member, Professor of Civil Engineering in the Zachry Civil Engineering Department of the Texas A&M University, and a Licensed Professional Engineer in Texas with a Ph.D. in Civil Engineering from the University of Texas (1967). He is internationally known for his work in the study of the effect of expansive soils on foundations, having given presentations on the subject worldwide. Dr. Lytton has selflessly presented to this forum at least 10 times in the last 11 years and has also presented in past FPA seminars.

Ms. Wylie, FPA Member, FPA Structural Committee Member, Chair of the FPA-SC-16 committee and is Past Chair of the FPA-SC-12 and FPA-SC-14 committees. Ms. Wylie earned her BSME from the University of Houston, and her MSME from Rice University and has completed 3 years of post-graduate work in Civil Engineering at Rice University. She has been performing forensic investigations at Forensic Engineers Inc. since 1999 and is a past presenter to the FPA.

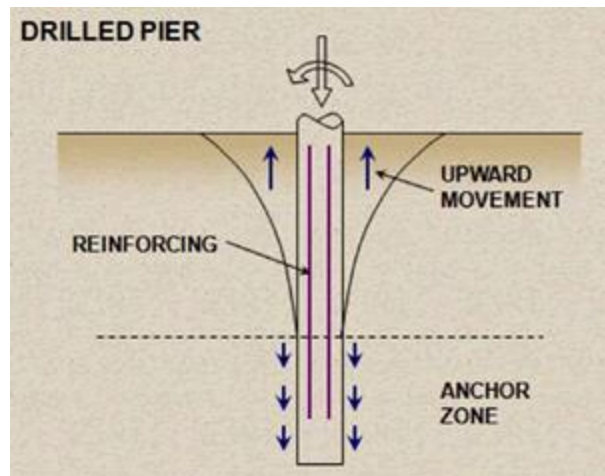
PRESENTATION SUMMARY

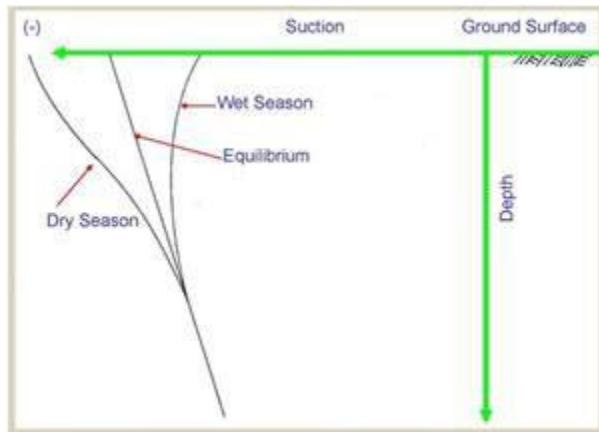
To an audience of approximately 70 attendees Dr. Lytton gave his presentation on the Design of Drilled Shafts in Expansive Soils. This presentation was the follow up or Part 2 of his presentation from December 2012.

Work by the [FPA-SC-16 committee](#), of which Dr. Lytton is a member, is nearing completion and the committee plans for its paper to go into peer review within a year. At the start of Dr. Lytton's presentation, Ms. Wylie, the committee's chair, presented an overview of her committee's work to date, and described how the supplemental procedure that Dr. Lytton is presenting may be used by the committee.

Much of the data presented was related to the estimation of the soil suction coefficient (pF) when no soils testing data is available. Dr. Lytton presented methods of estimating parameters of the suction envelope including seasonal variations. Dr. Lytton made several important observations including the effect of the root zones of trees on the estimates of the suction envelope and the effects of seasonal moisture variations on suction estimates.

Most of the data presented was based on field measured data included in studies that spanned decades. After presenting groups of data used to formulate the results, Dr. Lytton then demonstrated the application of the data in a spread sheet that can be used to calculate the parameters used for pier design. This spread sheet will be included the FPA-SC-16 Committee and will be available only to FPA members when complete. Dr. Lytton demonstrated how different data could be input into the spread sheet to provide a reasonably trustworthy estimate of usable design values.





Dr. Lytton gave his first presentation on the "[Design of Drilled Shafts in Expansive Soils](#)" to the FPA in December 2011. That presentation documented his development work to date of a new design procedure that was requested of him by the [FPA Structural Committee](#). Since then the Structural Committee sanctioned its ad hoc subcommittee no. FPA-SC-16 to develop Dr. Lytton's proposed procedure into a peer-reviewed design procedure for geotechnical and structural foundation engineers to use when designing drilled concrete shafts in active soil, with limited geotechnical data. The procedure being presented is intended to supplement the design procedure currently in committee and enhance its accuracy in determining proper pier sizes and depths.

Dr. Lytton was recently requested by his fellow committee members to develop a way to determine more accurately

the design suction of an active soil, based on limited geotechnical data, that considers when the soil sample is taken and when the pier gets installed. He has since developed a procedure that will calculate the design suction envelope based on the properties of the sample taken, the depth from which it was sampled, and the day of the yearon which it was sampled. Dr. Lytton's procedure determines the suction profile that fits through the sample's measured point on the sampled day and also determines the diffusivity that controls what that suction profile will be.

Diffusivity, the rate at which water enters and leaves the soils at all depths, is also needed to construct the suction envelope, i.e., the wettest suction and driest suction at all depths throughout the year. This will work even if the sample is taken in a tree root zone where the diffusivity is going to be higher because of the cracks in the soil that are caused by the tree roots. As with the rest of the design procedure the FPA-SC-16 committee is currently developing, actual suction testing will not be required to use this proposed supplemental procedure.

The procedure presented was developed to be used in the Houston area. However, the basic differential equation utilized in the procedure will apply to other areas of the country as well, provided those areas' climatological data for the past 20 years are retrieved from public sources and inputted to the equation.

To download a copy of Dr. Lytton's slide presentation, click [here](#).

To download a copy of Ms. Wylie's slide presentation, click [here](#).

To read summaries of previous FPA presentations by Dr. Lytton, please click:

- December 2012 - [Design of Pavements on Expansive Clay Subgrades](#)
- December 2011 - [Design of Drilled Shafts in Expansive Soils](#)
- December 2010 - [Effects of Trees on Foundations](#)
- December 2009 - [Contrasting Design Approaches for Slabs-on-Ground and Raised Floor Foundations on Expansive Soils](#)
- December 2008 - [How to use the PTI-3rd Edition to Design Foundations in Houston](#)
- December 2007 - [Design of Structures to Resist the Pressures and Movements of Expansive Soils](#)
- December 2006 - [Revisitation of Expansive Soils](#)
- December 2004 - [Case Studies of Residential Foundation Movements in Southern Houston Area](#)
- August 2003 - [How to Run Soil Suction Tests](#)
- August 2002 - [Shallow Slope Failures and Suction from Vegetation](#)
- August 2001 - [Methods to Aid Structural and Geotechnical Engineers in Designing Slab-on-Grade](#)