

DECEMBER 2015 MEETING

Wednesday, December 9, 2015 (1.5 PDH)

TECHNICAL PROGRAM

Edge Cracking in Pavements on Expansive Soils: Causes and Countermeasures

Speaker: Robert L. Lytton, Ph.D., P.E. Professor of Civil Engineering at Texas A&M University, Bryan TX, Tel. No. 979-845-9964

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 famous for his work in the study of the effect of expansive soil on foundations, having given presentations on the subject worldwide. Dr. Lytton has selflessly presented to this forum 13 times and has also presented in past FPA seminars.

PRESENTATION SUMMARY

Pavements on expansive soils must be designed both longitudinally and transversely. Longitudinal design is concerned with controlling the rate of increase of roughness in riding quality. Transversely, the design is concerned with edge cracking. There are several ways of accomplishing transverse design and they require an understanding of the potential causes and a selection of appropriate counter measure(s).

The potential causes are differential shrinkage or swelling of the supporting expansive subgrade, as follows:

- Differential horizontal shrinkage at the edge of the pavement
- Differential vertical shrinkage at the edge of the pavement
- Differential swelling in the center of the pavement
- Combination of differential shrinkage at the edge and swelling in the center



Basically, the last three cause the pavement to bend into a downward curvature at the edge of the pavement, thus making the transverse design a soil-structure interaction problem. All four are made more severe by the action of vegetation growing at the edge of the pavement and extracting moisture from beneath the pavement.

A soil-structure interaction problem involves the stiffness, thickness, and tensile strength of the pavement layers resting on the subgrade and the distribution of bending moment in the pavement structure at distances from the edge of the pavement. The location of the cracks that are caused by bending depend on the relative stiffness of the pavement structure and the soil it rests on.

The countermeasures include the following:

- Sufficiently high tensile strength in the pavement layers to provide a safety factor against bending tensile stresses at the critical location(s).

- Geosynthetics placed between the subgrade and the pavement structure or between the subbase and the surface course.
- Wide shoulders as a “sacrificial” layer to keep cracks away from the travelled lanes and use of periodic crack sealing.
- Vertical moisture barrier to stabilize the expected moisture change beneath the travelled lanes. This must be deep enough to reduce both the horizontal shrinkage and the downward curvature near the edge of the pavement.

Successful transverse design requires a realistic estimate of the amount of differential movement that is likely to be caused by the supporting expansive subgrade.

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

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

[December 2014](#) - Methylene Blue Test of Soil Properties: A Rapid and Accurate Field Test

[December 2013](#) - Design of Drilled Shafts in Expansive Soils. Part 2

[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