

The Sixth Michael W. O'Neill Lecture
FOUNDATION ENGINEERING FOR TRANSMISSION LINE STRUCTURES

Fred H. Kulhawy, Distinguished Member ASCE
Professor Emeritus of Civil / Geotechnical Engineering (and Geology)
School of Civil and Environmental Engineering, Hollister Hall
Cornell University, Ithaca, NY 14853-3501
Email: fhk1@cornell.edu

An overview is given of the development and practice of foundation engineering for electrical transmission line structures (TLS). The evolution of this specialty field has been very different from that for building and/or bridge structures. The differences are quite substantial and relate to the structure types, loading, threat to life, ground assessment over long corridors, construction issues, and various other factors. Unfortunately, these key issues are not addressed in traditional civil engineering references such as textbooks or design manuals, and they are not covered in standard university courses in foundation engineering. Accordingly, designers, constructors, and others in the electric utility industry have developed alternative approaches toward foundation engineering for TLS.

This presentation addresses this specialty field and discusses some pertinent issues regarding the structures, loading, foundations, geotechnical assessment, design philosophy, and construction issues. Regarding the foundations, two issues are paramount: (1) *simplicity and standardization* - of design, construction materials, and construction methods, and (2) *minimization* - of site preparation, field labor, and construction time. These two issues always tend to drive the design. Kulhawy and Hirany (2010) discuss this subject matter in more detail.

Selected pertinent references below introduce the reader to this broad topic.

SELECTED PERTINENT REFERENCES

- IEEE Foundation Design Standard Task Group & ASCE Transmission Structure Foundation Design Standards Comm. [A DiGioia & P Tedesco, Co-Chairs - F Dewey, T Keller, J Kramer, F Kulhawy, D LaGatta, F Manuel, D Marihugh, B Peters, P Taylor, W Thomas, R Wolfe & H Zaininger] (1985), "Trial-use guide for transmission structure foundation design", *Std. 691*, IEEE, New York, 216 p. [finalized as *IEEE Std. 691-2001*, 2001] [note: now somewhat dated technically]
- Kulhawy, FH & Hirany, A (2010). "Foundation Engineering for Transmission Line Structures", *The Art of Foundation Engineering Practice (GSP 198)*, Ed. M.H. Hussein, J.B. Anderson & W.M. Camp, III, ASCE, Reston (VA), 343-358.
- Kulhawy, FH, Phoon, KK, Prakoso, WA & Hirany, A (2006). "Reliability-based design of foundations for transmission line structures", *Electrical Transmission Line & Substation Structures: Structural Reliability in a Changing World*, Ed. RE Nickerson, ASCE, Reston, 184-194.
- Kulhawy, FH, Trautmann, CH, Beech, JF, O'Rourke, TD, McGuire, W, Wood, WA & Capano, C (1983). "Transmission line structure foundations for uplift-compression loading", *Rpt. EL-2870*, Electric Power Research Inst., Palo Alto, 412 p.

- Kulhawy, FH, Trautmann, CH & Hirany, A (2002). "Overview of some EPRI research for transmission line structure foundations", *Electrical Transmission in the New Age*, Ed. DE Jackman, ASCE, Reston, 282-291.
- Phoon, KK, Kulhawy, FH & Grigoriu, MD (1995). "Reliability-based design of foundations for transmission line structures", *Rpt. TR-105000*, Electric Power Research Inst., Palo Alto, 380 p.
- Rodgers, TE, Bobbitt, DE, Kulhawy, FH, Latham, RC, Melcher, RR, Perigo, CC & Reeside, WO (1991). "Guide for installation of foundations for transmission line structures, *Std. 977-1991*, IEEE, New York, 60 p.