

Numerical study on the long-term thermal performance and ground temperature variation of energy pile in multi-layered soil

Yimu Guo¹, Guozhu Zhang^{1*}, Songyu Liu¹, Yanjun Du¹, Zhibin Liu¹

¹ Institute of Geotechnical Engineering, Southeast University, Nanjing 210096, China

* zhanggz@seu.edu.cn

Abstract

Energy pile has been increasingly applied into buildings as both bearing structure and heat exchanger. In China, precast-high strength concrete (PHC) pipe pile is widely used in soft soil improvement, high-rise building construction and bridge foundation for its high bearing capacity, reliable quality, convenient installation and cost benefits. However, application of PHC pipe pile as geo-thermal structure is rare. Based on a field thermal response test on PHC pipe pile embedded in a particular multi-layered ground, the thermal response of pile is analyzed by numerical study. Thermo-physical properties of ground are tested from undisturbed soil samples from the site, then applied into multi-layered heat transfer model. Moreover, the influences of inhomogeneous thermal properties and thermal boundary conditions are analyzed in details, especially on long-term thermal performance and temperature field evolution in surrounded soil. The results indicate ground temperature varies apparently at the interface of soil layers, while temperatures within the layer are relatively uniform. Appropriate geological structure benefits the long-term performance of energy pile. This study provides a better understanding of energy pile performance in a more realistic ground condition and suggestions for design of PHC energy pile are proposed.