

ABSTRACT

This research focuses on the thermomechanical modeling and analysis of pile behavior under the coupled effects of hydration and mechanical loading. Three pile projects were considered in this study: the FIU pile project in Miami, the Sawgrass pile project, and the Okeechobee pile project. In the FIU project, the pile was instrumented with fiber optic sensors to monitor temperature and displacement during construction and loading. The collected data provide valuable information on temperature changes caused by cement hydration and the resulting structural response of the pile.

FLAC3D, a finite difference software commonly used in geotechnical engineering, was used to develop numerical models of the three pile projects. The models consider the thermal and mechanical properties of the pile and surrounding soil, as well as the soil–pile interface behavior to simulate axial load transfer along the pile. Laboratory-measured thermomechanical properties were incorporated into the models to account for temperature changes caused by cement hydration and their effects on material behavior. The numerical models were calibrated using available field measurements to evaluate the pile response under different loading conditions. In particular, the fiber optic measurements from the FIU pile project were used to investigate the temperature distribution during cement hydration and its influence on the mechanical response of the pile. The study also focuses on evaluating the load-transfer behavior along the piles and developing representative T–Z curves for the soil–pile interface. The results are expected to improve the understanding of pile behavior under thermal and mechanical loading conditions and provide useful information for numerical modeling and design of deep foundations.