ABSTRACT

Kwangkyun Kim. Ph.D., Purdue University, December, 2005. Cone Penetration Testing in Clayey Soil: Rate Effects and Application to Pile Shaft Resistance Calculations Major Professor: Rodrigo Salgado.

This research focuses on the evaluation of the factors affecting cone resistance measurement during cone penetration in saturated clayey soils and the application of the result to pile shaft capacity analysis. In particular, effects of drainage conditions around the cone tip were studied. In order to investigate the effects of drainage during cone penetration test, penetration tests were performed in the field and in a calibration chamber and the obtained data were analyzed. For the field tests, two sites which have homogeneous clayey soil layers under the groundwater table were selected by evaluating boring data, and CPTs were performed with various penetration rates. Penetration tests in calibration chamber were performed to investigate the transition points between undrained and partially drained, partially drained and fully drained conditions based on cone penetration rate and the coefficient of consolidation. A series of flexible-wall permeameter tests were conducted for various mixing ratios of clays and sands to obtain values of consolidation coefficient c_v which is important to determine mixing ratios of chamber specimens. Nine piezocone penetration tests were conducted for different penetration rates in calibration chamber specimen P1 (mixture of 25 % kaolin clay and 75 % Jumun sand) and eight penetration tests were carried out in calibration chamber specimen P2 (mixture of 18 % clay and 82 % Jumun sand). From the results of the penetration tests in the calibration chamber, a correlation between cone resistance and drainage condition was established. Cone factor N_k was evaluated based on collected CPT data having appropriate soil parameters. The correlations between N_k and selected soil properties which can affect cone resistance (PI, I_r, rate-dependent strength, and OCR) were examined and the new N_k correlation was proposed.

Static pile load tests using a 357mm closed-ended pile and an H-pile were performed and the obtained pile shaft resistance data were used for developing a new pile shaft capacity analysis method. The shaft capacity analysis method for piles in cohesive

soil was proposed based on the suggested correlation between cone resistance and undrained shear strength and the basic concept of the α-method. The factor α is computed differently for a displacement pile and a non-displacement or partial-displacement pile. For a displacement pile, the α factor associated with the normalized cone resistance ratio and length effect was established based on statistical correlation based on 15 closed-ended pile load test results. The α factor for non-displacement or partial-displacement piles was derived based on 12 pile load test results.