Abstract

The Self Boring Pressuremeter (SBP) test is an important in-situ testing technique providing fundamental soil properties to the geotechnical engineer. The installation process however, can severely disturb the original mechanical state of the surrounding soil. It is therefore vitally important to understand the mechanism of the disturbance effects and their influence on the subsequent pressuremeter test.

This project focuses on four main disturbance effects for the SBP in clay: underdrilling, overdrilling, smearing and the geometry effect. The Strain Path Method (SPM) which is an analytical framework to describe the undrained penetration of clay is adapted to simulate these disturbances. The drilling process is examined as an incompressible fluid flowing around the stationary object of the Self-Boring Pressuremeter. Different boundary conditions are applied to simulate the four different disturbance effects. Velocities are used to derive the strain rates on a given streamline. Integration of the strain rates along the streamlines defines the historic strain paths for individual soil elements moving around the pressuremeter. Once the strain profile is determined a constitutive model is needed to derive the effective stress profile. There are two models applied in this study, the Modified Cam Clay (MCC) Model is used as benchmark to illustrate the general soil behaviour. Wongsaroj's Model is also used to describe more sophisticated soil behaviour during drilling. Pore pressures are deduced from the effective stress profile for each disturbance effect using the equilibrium condition and effective stress theory.

The effective stresses and pore pressure fields are defined as the initial state of the disturbed pressuremeter test. By analyzing the disturbed test curves, it can be found that the drilling disturbances significantly influence the derivation of the soil properties from both cavity expansion and contraction curves, and the soil permeability and the excess pore pressure dissipation are also important issues to consider for practical implications.

The disturbance effect of the Self-Boring Pressuremeter test in drained conditions e.g. Thanet sand is simplified to a cavity contraction occurring before the test proper. The movement of the cavity including disturbance therefore can be described as a contraction-expansion-contraction process. **Yu (2000)'s** solution is extended to characterize the overdrilled pressuremeter test. However since the linear-elastic-perfectly-plastic nature of the Mohr Coulomb model cannot accurately regenerate the pressuremeter test curve particularly for the contraction phase which is the part of the curve which shows the most non-linearity, a more sophisticated constitutive model called the Modified Mohr Coulomb Model (MMC) is derived.

The new model embeds the non-linear elasticity and strain hardening and softening properties into the ordinary Mohr Coulomb model. Four Self-Boring Pressuremeter tests analyzed by both the extended Yu's analytical solution and the numerical solution using the MMC Model show that the overdrilling effect is the main disturbance for pressuremeter test in sand and the simulated test curves based on the advanced soil model match the measured data.

Although the disturbance effects have been discussed from the numerical simulation perspective, it is also vitally important to have real field test data to validate the numerical modelling. Cambridge Insitu Ltd has designed and manufactured a Self Boring Pore Pressure Machine directly to monitor the pore pressure variation during drilling. The description of this instrument and its future application is given.