

ABSTRACT

Zhang, Jie. Ph.D., Purdue University, May, 2005. Cavity expansion in lightly cemented sands. Major Professor: Rodrigo Salgado.

Cavity expansion theories are widely used in geotechnical engineering area, such as interpreting in-situ test data to get soil information, estimating bearing capacity of deep foundations, and analyzing stability and deformation of excavation and tunneling. The primary objective of this study is to perform cavity expansion analysis in lightly cemented sands by implementing an appropriate constitutive model into a program CONPOINT. Comparing with uncemented sands, cemented sands have higher strength and stiffness, lower strains to yield and higher dilatancy. The stress-dilatancy relationship of cemented sands is not the one-to-one type. Because of the differences in mechanical behavior between cemented and uncemented sands, a framework for describing the behavior of cemented sands was established first, under which an extended Mohr-Coulomb model for cemented sands was proposed. Based on Rowe's relation, a stress-dilatancy relation for cemented sands was derived and then adopted as a flow rule in the proposed model. Both friction angle and cohesion in the model vary according to soil state and strain history. Upon satisfactorily simulating the triaxial test data on two artificially cemented sands, the proposed model was implemented into the CONPOINT program. Through numerical analysis, it has been found that, at low confining pressures, cementation greatly changes the stress and strain distributions in the plastic zone around the cavity; while at high confining pressures, the changes in stress and strain are not obvious as those at low confining pressure.