Dilatancy of Remoulded Fine-grained Soils

by

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ABSTRACT

Along with the development of the formulation of suitable constitutive relationships for geomaterials, dilatancy has become a common feature of the soils which studied by geotechnical engineers, and is a part of the broader topic of soil mechanics. To study the mechanical behaviour especially the dilatancy of a remoulded fine-grain soil under different stress paths in triaxial space, in this research, the investigation was performed in the laboratory with triaxial tests on remoulded kaolin clay samples. The triaxial tests included isotropic and anisotropic consolidation as well as drained and undrained triaxial compression tests. The tests data is interpreted within the framework of critical state soil mechanics. Evolution of dilatancy is evaluated under different stress paths.

During constant stress-ratio shearing, it is found that the dilatancy of the soil is not a constant but varies at the very beginning due to induced anisotropy. However, when strain becomes higher, dilatancy approaches a constant for a specific stress ratio. Soil shears under smaller η produces large dilatancy. For specimen that isotropically consolidated, the dilatancy D tends to infinity. The dilatancy of the soil during constant p' shearing and conventional drained shearing decreases as η increases and it approaches to zero as η approaches M_c.

A model for saturated soil is presented, modified from an unsaturated model for soil proposed by Li (2007). Based on the presented model, the modified Cam clay model, the original Cam clay and Rowe's stress-dilatancy relationship, the experimental findings of some laboratory triaxial tests are discussed.

The yield surface presented by the model modified from Li's unsaturated model was drawn and compared to the test results, with some calibrated or assumed model

constants. Experimental data indicate that the shape of the yield curve presented by the model modified from Li's model is a reasonable approximation for the soil.

The data from the constant η compression, constant p' shearing and conventional drained compression tests were analyzed. It is found that the model modified from Li's model gives a much better agreement than other models under constant η compression, none of these theoretical flow rules is appropriate for matching the experimental data for this soil under constant p' shearing, and the modified Cam clay model gives a much better agreement than other models for soil under conventional drained compression.

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 2

Chapter 3

Chapter 4

Chapter 5

LIST OF TABLES

NOMENCLATURE

ψ . state parameter

Γ_{cr}, λ_{cr} . parameters associated with the critical state line in e-ln p' plane

D . dilatancy

e void ratio

G elastic shear modulus

G_S specific gravity

K elastic bulk modulus

M critical stress ratio for triaxial compression

ν Poisson's ratio

w water content

ε_a axial strain

ε_q deviatoric strain

ε_r radial strain

ε_v volumetric strain

η stress ratio, q / p'

κ isotropic unloading slope in e-ln p' plane

σ_a axial stress in triaxial test

σ_r radial stress in triaxial test

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