

# Relation Between the Shear Strength of Sands in Plane Strain and Simple Shear

Nobuchika MOROTO

## Abstract

Theoretical relation which derived between the peak  $\phi$  values for sand in the simple shear test and the plane strain test was numerically analyzed. Available experimental data indicate quite close agreement over a wide range of  $\phi$  for cohesionless soils

## Introduction

The plane strain condition is commonly encountered in the geotechnical problems. It has been noted that the Coulomb  $\phi$  measured in plane strain test differs from that measured in simple shear test. If one can predict the plane strain strength  $\phi_p$  from the simple shear strength  $\phi_s$ , this seems to be very convenient.

In this paper, the relation which derived between the drained peak  $\phi$  values for sand in the plane strain test and the simple shear test is numerically analyzed and the result is evaluated by using available experimental data for cohesionless soils.

## Basic Equation

Studied the stress-dilatancy performance of sand in simple shear with the assumption that the directions of principal strain increment and principal stress coincide, the author derived a relation between the peak Coulomb  $\phi$  values for drained sand measured in the plane strain test and the simple shear test as follows ;

$$\sin \phi_p = \frac{\tan \phi_s \sqrt{1 + \tan^2 \phi_s}}{\sqrt{1 + \tan^2 \phi_s}} \quad (\text{the sliding block model}) \quad (1)$$

$$\sin \phi_p = \frac{\tan \phi_s \sqrt{1 + (\tan \phi_m - \tan \phi_s)^2}}{\sqrt{1 - \tan \phi_s (\tan \phi_m - \tan \phi_s)}} \quad (\text{the author's S-model}) \quad (2)$$

where

$$\begin{aligned} \tan \phi_s &= (\tau/\sigma)_{\max} \\ \sin \phi_p &= \left( \frac{\sigma_1 - \sigma_3}{\sigma_1 + \sigma_3} \right)_{\max} \end{aligned}$$

(Moroto, 1986)

---

Received October 31, 1986

\* Dept. of Civil Engg., Professor