

SHEAR STRENGTH OF SANDS

by

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Abstract

The influence of void ratio and vibrations on the behaviour of dry sands in pure shear has been investigated assuming sand as a regular packing of equal sized elastic spheres. The frictional component of the shear resistance mobilized depends upon the interparticle friction, void ratio and effective normal stress, & is independent of particle size and shape, and is given by the expression

$$\tau = \sigma_{eff} \tan (\phi + \alpha)$$

where

σ_{eff} = effective normal stress

ϕ = Average coefficient of friction between the particles, which is a constant for any particular sand.

Depends upon the surface condition of the particles.

α = The angle representing the structure of the packing. In an ideal packing of spheres, it is the angle between the interparticle displacement vector and the shear force vector. This angle depends only upon the void ratio e and can be calculated from the following relationship developed for a regular packing of spheres.

$$4.964 \sin (\alpha + 35^{\circ} 15) \cos (\alpha + 35^{\circ} 15) - 1$$

α varies between the limits $0 - 19^{\circ} 30$ corresponding to the variation in void ratio from $0.35 - 0.92$.

Under vibrations the decrease in the shear resistance mobilized is due to reduction of σ_{eff} only. ϕ and α are not affected by vibrations. The value of σ_{eff} depends upon the method of excitation and the phase difference between the excitation force vector and acceleration vector of the induced vibrations. It has to be calculated by using a proper analogy for the soil and loading system.

To verify the results of this analytical study extensive tests

have been conducted on specially designed dynamic shear apparatus using a modified shear box. Tests have been conducted on four types of sands. Published results from other investigators have also been used for comparison. Very good agreement exists between the experimental and analytical results. With special experimental techniques the stress distribution in the shear box as well as the movement of individual soil particles during shear at various heights of the sample in a shear box have been measured. These results also confirm the observations from analytical study.

As a result of this work, it is now possible to properly interpret the results of direct shear test and calculate the shear strength of sands to a high degree of accuracy if the void ratio and loading conditions are known.

DEDICATION

Thankfully dedicated to the supernatural force, God, who
has guided me always in the form of Lord Venkateswara:

Thanks for the beautiful mornings,
Thanks for every new day,
Thanks, that I can pour out
all my sorrows to you.

Thanks for all my good friends,
Thanks for all whom I meet,
Thanks for the will
to forgive my enemy.

Thanks for my job,
Thanks for every bit of luck,
Thanks for the harmonious, the melodious
and for the music.

Thanks also for all disappointments,
Thanks for every kind word,
Thanks, that your hand directs
me every where.

Thanks, that I understand your word,
Thanks, that you give me the will,
Thanks, that you love all men
far and near.

Thanks, your healing power has no limits,
Thanks, that I can depend upon it,
Thanks, Oh God, I do thank you,
that I can thank you.

(Translated from "DANKEN" 1. Preis des Preisausschreibens
der Evangelischen Akademie, Tutzing. Record - Electrola -
45 EG 9258)

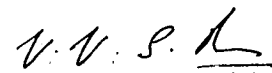
FOREWORD

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