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## SUMMARY

Old Alluvium (OA) is an alluvial deposit found predominantly in southern Malaysia, Singapore and in the offshore zone to the east of Singapore. The soil came from the weathered materials from mountain slopes in Johor Bahru, Malaysia and was deposited by a braided river system when sea level dropped significantly during the Pleistocene era . Due to this depositional process, this natural soil mix is very heterogeneous, exhibiting wide range of properties. Its strength and stiffness at a given depth differ by an order of magnitude, and this cannot be explained by difference in density and water content.

A research program was started by the National University of Singapore to characterize the properties of Singapore Old Alluvium. The objectives of this research are to classify OA and to investigate sampling disturbance, in-situ horizontal stress, and shear strength of OA. Both laboratory and field tests were carried out. Intact and reconstituted samples were used for laboratory study.

Composition analysis found the majority of OA is clayey sand and literature review in geology found OA had an over-consolidation stress history. The clay content and stress history helps OA to resist sampling disturbance. However, the current commonly used thick-wall samplers need to be improved.  $K_o$  values of normally consolidated OA can be predicted by Jaky's equation, but the over-consolidation stress history resulted in scattered  $K_o$  values due to different OCR values and soil composition.

The concept of granular void ratio  $e_g$  is used to explain the apparently high degree of variability in shear strength. The importance of identifying fine content is highlighted. The fines' influence on strength is based not only on size but also on mineralogy. It is further postulated that the present way of calculating granular void ratio needed to be

modified to accommodate such a natural soil with wide range of grading, different mineralogy and over-consolidation history. A new concept, the equivalent granular void ratio  $e_{ge}$ , is developed by assigning different contribution factors to different fines. Results from a series of isotropic consolidated undrained triaxial tests and particle size distribution tests on high quality OA samples revealed that strength and stiffness of material is governed by equivalent granular void ratio  $e_{ge}$  rather than the global void ratio  $e$ . The importance of understanding the mineralogical composition, structure and stress history in characterization of natural soils is highlighted.

**Key Words:** Soil Characterization, Triaxial Tests, Sampling Disturbance,  $K_o$ , Shear Strength, Sand Mixture

# LIST OF SYMBOLS

## English Letters:

$A$	sample area
$a$	bellofram area (Chapter 3)
$a$	contribution factor for clay in OA (Chapter 6)
$a'$	suction cap seal area (Chapter 3)
$B$	pore water pressure coefficient
$b$	contribution factor
$CC$	clay content
$C_u$	undrained shear strength
$d_s$	depth of the soil sample
$e$	void ratio
$e_g$	granular void ratio
$e_{ge}$	equivalent granular void ratio
$e_s$	intergranular void ratio
$e_f$	interfine void ratio
$E$	Young's modulus
$E_{PMT}$	pressuremeter modulus from the first cycle of test
$E_r$	unloading-reloading modulus of the second cycle in pressuremeter tests
$E_s$	secant Young's modulus
$E_{us}$	secant Young's modulus in undrained loading
$E'_{us}$	normalized secant Young's modulus in undrained loading

$FC, f_c$	finer content
$G$	shear modulus
$G_s$	specific gravity
$k$	permeability
$K_a$	active earth pressure coefficient
$K_o$	earth pressure coefficient at rest
$K_p$	passive earth pressure coefficient
$N$	SPT value
$p$	mean stress
$p'$	mean effective stress
$p_c$	pressure in lower pressure chamber
$p_c'$	consolidation pressure
$p_{ss}'$	mean effective stress at steady state
$p'_{us}$	undrained steady state mean effective stress
$P_0$	lift-off pressure in pressuremeter tests
$P_L$	limit pressure in pressuremeter tests
$P_y$	yield pressure in pressuremeter tests
$q$	deviator stress
$q_{us}$	undrained steady state deviator stress
$S_{us}$	undrained shear strength
$S_{us, qss}$	undrained shear strength at quasi steady state
$w$	water content
$W$	weight of loading ram and the sample

### Greek Letters:

$\varepsilon_a$	axial strain
$\varepsilon_c$	cavity strain
$\gamma$	unit weight
$\eta$	stress ratio = $q/p'$
$\eta_{max}$	maximum stress ratio
$\rho$	cavity radius
$\rho_0$	initial cavity radius
$\sigma$	normal stress
$\sigma_a$	axial stress
$\sigma'_a$	effective axial stress
$\sigma'_h$	effective horizontal stress in-situ
$\sigma_r$	radial stress; cell pressure
$\sigma'_r$	effective consolidation pressure; effective radial stress
$\sigma_v$	vertical stress
$\sigma'_v$	effective vertical stress
$\phi$	critical state angle of shearing resistance
$\nu$	Poisson's ratio
$\psi$	state parameter for sand
$\psi_f$	interfine state parameter
$\psi_s$	intergranular state parameter

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