ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my supervisors, Dr. Ganeswara Rao Dasari (formerly Assistant Professor at NUS) and Associate Professor Tan Thiam Soon, for their invaluable guidance in science, technology and philosophy. I also wish to thank visiting professors S. Leroueil, J. Locat, and D. W. Hight, for the wonderful advices they have provided.

My appreciation also extends to all the laboratory officers in the Geotechnical Engineering Laboratory, especially to Mdm Jamilah, Mr. John Choy, Mr. Foo Hee Ann, and Mr. Shen Rui Fu, for their help in performing the tests. I am also grateful to Miss Elly Tenando and all the postgraduate students in the laboratory, for the friendly working environment they all have created. Special thanks go to Yang Haibo, who helped in making this hardbound copy and various other things after I left Singapore.

I am in full gratitude to my family for supporting me all the time, especially to my wife, Cindy Zhao Yingzi, who gives me limitless love, care and encouragement.

Finally, I deeply appreciate the financial assistance provided by National University of Singapore, which helped me to take one decisive step in the journey of my life.

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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
Cu	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, *fc*	fines 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:

ε_a	axial strain
ε_c	cavity strain
γ	unit weight
η	stress ratio = q/p'
η_{max}	maximum stress ratio
ρ	cavity radius
ρ_0	initial cavity radius
σ	normal stress
σ_a	axial stress
σ'_a	effective axial stress
σ'_h	effective horizontal stress in-situ
σ_r	radial stress; cell pressure
σ_r'	effective consolidation pressure; effective radial stress
σ_v	vertical stress
σ'_v	effective vertical stress
ϕ	critical state angle of shearing resistance
υ	Poisson's ratio
ψ	state parameter for sand
ψ_f	interfine state parameter
ψ_s	intergranular state parameter

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