THE EFFECT OF FABRIC ON THE BEHAVIOUR OF GOLD TAILINGS

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THESIS SUMMARY

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The behaviour of cohesionless soils is known to be influenced by the method of reconstitution. It is generally accepted in the literature that different reconstitution methods produce samples of varying fabric and thus samples of varying behaviour. Very little evidence has been presented to validate this statement. The main aim of this is thesis is firstly to observe the fabric of in situ and reconstituted gold tailings samples and secondly to investigate the difference in behaviour between these samples at the same state.

The investigation focused on testing in situ and reconstituted gold tailings samples obtained from 3 positions on a tailings dam; pond, middle beach and upper beach. Laboratory reconstitution methods included moist tamping and slurry deposition. Fabric analysis involved the use of SEM images to classify the observed differences in the fabric of the undisturbed and reconstituted gold tailings samples. A particle interaction model based on the observed fabric was postulated to explain the differences or similarities in behaviour. The scope of behaviour investigated included sedimentation, collapse and swell, consolidation and compressibility, creep, stiffness and shear behaviour.

The fabric analysis indicates that differences in the fabric of undisturbed and reconstituted gold tailings samples are visible. Moist tamping produces an aggregated fabric while slurry deposition yields a homogeneous fabric similar to that of the undisturbed samples. Comparison of behaviour indicates that neither moist tamping nor slurry deposition can replicate the behaviour of the undisturbed sample fully. Consolidation and compression is a function of the fabric while friction angle is independent of the fabric. Available shear strength and liquifaction potential is also affected by the preparation method and the resulting fabric.

Keywords: Tailings, gold, fabric, behaviour, aggregated, liquefaction, strain-softening, sample preparation, moist tamping, slurry deposition .

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List of Symbols

Roman symbols

A	Area of electrodes, cross-sectional area of sample
a	Constant
A_0	Initial sample area
b	Constant
c'	Effective cohesion
C_α	Secondary compression index
CC	Clay content (% of material <0.002mm)
C_c	Compression index
CR	Creep rate
C_u	Coefficient of Uniformity = D_{60}/ D_{10}
C_v	Coefficient of consolidation
C_z	Coefficient of Curvature = $D_{30}^2/(D_{10}D_{60})$
D_{10}	Effective size in mm where 10% of the material passes
D_{15}	Effective size in mm where 15% of the material passes
D_{30}	Effective size in mm where 30% of the material passes
D_{50}	Effective size in mm where 50% of the material passes
D_{60}	Effective size in mm where 60% of the material passes
D_{90}	Effective size in mm where 90% of the material passes
d	Drainage path length
E	Young's modulus
e	Void ratio
e_0	Initial void ratio

e_{max}, e_{min}	Maximum and minimum void ratio determined from limiting density test
FC	Fines content (percentage of material <0.075mm)
G_{max}	Small strain shear stiffness
Gs	Specific gravity of soil particles
H	Horizontal distance down the beach of a tailings dam.
I_B	Brittleness index
I_D	Relative density
K	Bulk modulus
k	Permeability
L	Distance between electrodes (Electrical conductivity), length of particle
LL	Liquid limit
M	Slope of the critical state line
m_v	Coefficient of compressibility
N	Intercept of the normal compression line at p' = 1kPa.
P	Applied pressure
p'	Mean normal effective stress
PI	Plasticity index
PL	Plastic limit
q'	Effective deviatoric stress
q_0'	Initial deviatoric stress (defining origin)
R	Resistance (Electrical conductivity)
r	Entrance pore radius
S	Wood's stability ratio
s'	$(\sigma_1'+\sigma_3')/2$
SR	Shear rate
t'	$(\sigma_1'-\sigma_3')/2$
t_{90}	Time for 90% consolidation
Ue	Excess pore pressure
W	Width of particle

Greek symbols

ε	Strain, normally in percent
ε_a	Axial strain
ε_v	Volumetric strain
ε_{a0}	Initial point defining origin
θ	Contact angle (MIP), stress path direction
λ	Slope of the normal compression line
σ	Surface tension of intruding liquid, Specimen conductivity, stress
σ_f	Conductivity of pore fluid (Electrical conductivity)
σ_v, σ_h	Vertical and horizontal conductivity (Electrical conductivity)
σ_{dp}, σ_{dr}	Peak and residual undrained shear strength
φ'	Effective angle of internal friction