Advanced Experimental Unsaturated Soil Mechanics

EXPERUS 2005

Edited by

A. Tarantino
Università degli Studi di Trento, Trento, Italy

E. Romero
Universitat Politècnica de Catalunya, Barcelona, Spain

Y.J. Cui
Ecole Nationale des Ponts et Chaussées, Paris, France
# Table of Contents

**Preface**  xi

**Acknowledgements**  xiii

**Organisation**  xv

## Suction measurement

- Lessons learnt from suction monitoring during centrifuge modeling  3
  C.F. Chiu, Y.J. Cui, P. Delage, E. Hazza & E. De Laure

- Pressure pulse technique for measuring diffused air volume  9
  C.A. Lawrence, W.N. Houston, A.M. Harraz & S.L. Houston

- A new soil-water characteristic curve device  15
  J.M. Padilla, Y.Y. Perera, W.N. Houston & D.G. Fredlund

- Soil suction measurement using the Xeritron Sensor in two different types of infiltration tests on a swelling soil  23
  G.A. Siemens & J.A. Blatz

- Swelling and suction in clay minerals  27
  V.K.S. Thakur & D.N. Singh

- The effect of structure on the water retention of soil tested using different methods of suction measurement  33
  S.C. Walker, D. Gallipoli & D.G. Tolls

## Suction control

- Controlled suction oedometeric tests: analysis of some experimental aspects  43
  C. Airò Farulla & A. Ferrari

- Behavior upon drying-wetting paths of Maghnia Bentonite (west of Algeria)  49
  N. Abou-Bekr, F.M. Derfouf & A. Bekkouche

- An investigation into hydro-mechanical behavior of an expansive soil using axis-translation and vapor equilibrium techniques  53
  S.S. Agus & T. Schanz

- Combining different controlled-suction techniques to study expansive clays  61
  C. Hoffmann, E. Romero & E.E. Alonso

- On the suction control techniques in studying the THM behavior of unsaturated soils  69
  S. Taïbi, M.S. Ghembaza & J.M. Fleureau

- Determination of water retention curves of two bentonites at high temperature  77
  M.V. Villar, P.L. Martin & A. Lloret
Mechanical testing in unsaturated soils

A direct shear box improved with the osmotic technique
M. Buso, A. Tarantino & L. Mongiovì

Volume change measurement of partially saturated rockfill in triaxial tests
C. Chávez, E. Romero & E.E. Alonso

Advancement in oedometer testing of unsaturated soils
M. El-Sohby, O. Mazen & M. Aboushock

A tensile strength apparatus for cohesionless soils
N. Lu, B. Wu & C.P. Tan

Direct shear testing of interfaces in unsaturated soil
G.A. Milfer & T.B. Hamid

Measuring lateral pressures during suction-controlled one-dimensional consolidation
E.E. Slatter, S.G. Fityus & D.W. Smith

Determination of the shear strength of unsaturated soils using the modified ring shear apparatus
S.K. Vanapalli, V.K. Garga & J.A. Infante Sedano

Experimental study of flowslide on reconstituted samples of pyroclastic soils: soil characterization and testing devices
M.C. Zingariello, L. Pagano & C. Mancuso

Mechanical behaviour of unsaturated soils

Wetting paths upon shearing: experimental evidence and comparative analysis of two volcanic soils in the area of Napoli and Roma
M. Cecconi, A. Evangelista, M.V. Nicotera, V. Pane, E. Cattoni & A. Scotto di Santolo

Seasonal variation of a subgrade soil resilient modulus in southern Brazil
J.A. Ceratti, W.Y.Y. Gehling & W.P. Núñez

Wetting and anisotropic consolidation behaviour of an expansive clay
R. Chen & C.W.W. Ng

Swell and shrink tests in modified oedometer apparatuses
M. Dobrowolsky & C. Vrettos

A study of the shear strength of two unsaturated colluvium soils
C. Feuerharmel, A.V.D. Bica, W.Y.Y. Gehling & J.A. Flores

Direct shear and compression behaviors for an unsaturated compacted soil with water content and matric suction measurement
D. Horndee, H. Ochiai & N. Yasufuku

Investigations on the unsaturated stress-strain behaviour and on the SWCC of Hostun Sand in a double-walled triaxial cell
C. Lauer & J. Engel

Analysis of the deformability of compacted tropical residual soils
G.S.S. Martinez, W.Y.Y. Gehling & A.M.M. Castaneda

Stiffness of unsaturated compacted clayey soils at very small strains
C.E. Mendoza, J.E. Calmenares & V.E. Merchán

Experimental and modeling of unsaturated soil behavior under stress path tests
S.A. Mofiz, D.C. Sarker & M.R. Taha
Stresses and conjugate strain-increments in plotting experimental data for unsaturated soils
E.J. Murray & V. Sivakumar

Influence of matric suction on the shear strength of a compacted Kaolinite under
unconfined conditions: Experimental results (Part 1)
J.A. Pineda & J.E. Colmenares

Influence of matric suction on the shear strength of compacted Kaolin soil under
unconfined conditions: Shear strength prediction (Part 2)
J.A. Pineda & J.E. Colmenares

Stress-strain behavior of an unsaturated residual soil from gneiss
R.M. Reis & O.M. Vilar

Experimental study of the effect of cyclic suction loading on shear behavior of collapsible soils
K.A. Shemw, S. Kiyama, S. Aoyama & A. Kobayashi

Influence of sample preparation technique on the stress-strain behaviour of unsaturated soils
R. Sivakumar, R. Thom, V. Sivakumar & D. Hughes

An elastoplastic hydro-mechanical model for unsaturated compacted soils
D.A. Sun & D.C. Sheng

Seismic compression behaviour of non-plastic silty sands
D.H. Whang, M.S. Moynear, P. Duku & J.P. Stewart

An empirical relationship for evaluating collapsible settlements of volcanic ash sandy soil
N. Yasufuku, H. Ochiai & D. Hormdee

A direct testing method for the tensile strength of compacted clays
R.M. Zeh & K.J. Witt

Hydraulic testing in unsaturated soils

Unsaturated soil diffusivity measurements
R. Bulut, C.P. Aubeny & R.L. Lytton

Quasi-steady centrifuge method for unsaturated hydraulic characterization
M.C. Caputo & J.R. Nimmo

Numerical modeling of constant flow method for measuring unsaturated hydrologic properties
W.J. Likos, N. Lu & A. Wayllace

The centrifuge permeameter for unsaturated soils (CPUS)
J.S. McCartney & J.G. Zornberg

Experimental hydraulic measurements in an unsaturated swelling soil using the dual-energy
gamma-ray technique
S. Rolland, F. Masrouri, D. Stemmelen & C. Moyne

Hydraulic behaviour of unsaturated soils

Establishment of new tropical soils differentiation factors considering suction and soil genesis
F.A.R. Araújo, R.G. Carvalho & E. Vertamatti

Assessment of Fredlund & Xing’s soil-water characteristic equation for tropical soils
F.A.R. Araújo, R.G. Carvalho & E. Vertamatti
An experimental evaluation of unsaturated hydraulic conductivity functions for a quasi-saturated compacted soil  
K.V. Bicalho, D. Znidarcic & H.Y. Ko

Soil-water characteristics and volume change behavior of an artificially cemented expansive clay  
H. Bilse & Ş. Oncu

Some remarks on physicoempirical models for the prediction of the soil water retention curve  
M. Cecconi, V. Pane & S. Vecchietti

Determination of the soil-water characteristic curve of undisturbed colluvium soils  
C. Feuerharmel, W.Y. Gehling & A.V.D. Bica

Use of soil-water characteristics curve in determination of stability of embankments during drying and wetting processes  

A model to predict the soil water characteristics of sand mixtures  
E. Imre, K. Havran, J. Lorincz, K. Rajkai, T. Firgi & G. Telekes

Evaluation of air permeability of unsaturated sandy soils  
K. Kamiya, R.T. Bakrie & Y. Honjo

Evaluation of moisture-suction characteristics of a lateritic soil submitted to infiltration by caustic liquor  
M.P.H. Moncada, T.M.P. De Campos, FS. Antunes & A.V.F.A Bertolino

Gas permeability evolution of a sand/bentonite during controlled-suction paths  
E. Romero, I. Garcia & J. Knobelsdorff

Water retention curves of lime stabilised soil  
G. Russo

Investigating water retention characteristics upon wetting paths using water-undrained compression tests  
S. Tombolato, A. Tarantino & L. Mongiovi

Estimation of the soil-water characteristic curve of coarse-grained soils using one point measurement and simple properties  
S.K. Vanapalli & M.C. Catana

Microstructure investigation

Compressibility and fabric of an unsaturated compacted swelling soil  
O. Cuizinier & F Masrouri

Influence of moisture content on porosity features of Red clay  
L.W. Kong, A.G. Guo, Y.W. Zhao & Y.Y. Liu

Chemical and mineralogical properties of Residual tropical soils and their relationships with selected geotechnical properties  
G.S.S. Martinez, J.A.A. Flores & J.B. Queiroz de Carvalho

Techniques of sample preparation of artificial cemented highly collapsible soil  
G.M. Medero, F. Schnaid, W.Y. Gehling & S.J. Wheeler

Microstructure of clay-sand mixtures at different hydration states  
R. Viola, M. Tuller, D. Or & J. Drasdis
Drying induced alteration to the microstructure of a tropical soil
G. Zhang, J.T. Germaine & A.J. Whittle

Geo-environmental testing
Temperature effects on the water content-suction relation of two soils

On the retention properties of a polluted sand-silt mixture
M. Manassero, G. Musso, C. Rabozzi & L. Ribotta

Image analysis to determine the dispersion coefficient and dispersivity in capillary and saturated zone
K. Inoue, K. Inoue, T. Tanaka & A. Kobayashi

An experimental evidence in desiccation cracking in sandy silt
H. Péron, L. Laloui & T. Hueckel

Thermo-hydro-mechanical tests using vapor and liquid transfer on a clay based mixture
E. Romero & X.L. Li

Assessment of swell-shrinkage behavior of compacted sedimentary residual soil for potential use in landfill liner

Field measurement and monitoring in field applications
Laboratory versus field values of unsaturated soil diffusivity
C.P. Aubeny, R. Bulut & R.L. Lytton

Further tests on the fissuring of clay fill at the thorngumbald flood embankment
M.R. Dyer

In situ testing of unsaturated organic soils
K. Garbulewski, Z. Bereda, Z. Chaciński, S. Pisarczyk & P. Popielski

Field monitoring of matric potential and soil water content in the chalk unsaturated zone
A.M. Ireson, H.S. Wheater, A.P. Butler, J. Finch, J.D. Cooper, R.G. Wyatt & E.J. Hewitt

The use of the ground penetrating radar, GPR, as a non intrusive method to measuring soil water content
S.L. Machado, M.A.B. Botelho, N.S. Amparo & T.C. Dourado

Instrumentation and matric soil suction measurement in a decomposed granite soil slope

Monitoring matric suction profiles in partially saturated pyroclastic topsoil slopes
A. Scotto di Santolo, M.V. Nicotera & A. Evangelista

Numerical modelling of soil suction measurements in pyroclastic soils
G. Sorbino

First results of a monitoring experiment for the analysis of rainfall induced landslides
A. Thielen & S.M. Springman

Evaluation of evapotranspiration from alternative landfill covers at the Rocky Mountain Arsenae
J.G. Zornberg & J.S. McCartney

Author Index