



Introduction to Unsaturated Soil Mechanics

Presented by the Department of Civil Engineering, University of Pretoria

7 - 8 February 2022

2 ECSA CPD Points

The **Introduction to Unsaturated Soil Mechanics** short course is a one-day course focusing on the theoretical framework and practical aspects of unsaturated soil mechanics in geotechnical engineering. The emphasis is on fundamental principles, stress state variables, steady-state and transient flows, soil-water characteristics, theory of shear strength and its measurement, soil stiffness, plastic and limit equilibrium analyses of earth pressures, slope stability and bearing capacity. Attention will be paid on how to extend classical saturated soil mechanics to encompass unsaturated soil behaviour. Engineering applications and the application of unsaturated soil mechanics in design are also discussed.

The aim of this course is to enable students, researchers and engineers to understand the fundamental principles and advanced concepts of unsaturated soil mechanics and their applications to geotechnical and geo-environmental engineering problems such as landfill cover systems, concrete block retaining walls, embankment, etc.

The course is presented by Dr Talia da Silva Burke. Talia is a senior lecturer at the University of Pretoria, and registered professional engineer. She completed her PhD at the University of Cambridge on a Gates Cambridge Scholarship where she researched the behaviour of geosynthetic-reinforced soils above voids. Talia has worked in consulting specialising in geo-environmental engineering with Jones & Wagener and as a Research Associate at the University of Cambridge researching piled foundations in expansive clays.

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Shifting knowledge to insight



Introduction to Critical State Soil Mechanics

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Course content

- Introduction to fundamental principles of unsaturated soil mechanics and the soil water characteristic curve
- State variables and measurement of soil suction
- Seepage and unsaturated permeability
- Unsaturated shear strength and stiffness theory and measurements
- Volume change and deformation, including Barcelona Basic Model
- Engineering applications of unsaturated soil mechanics.

Learning outcomes

After successfully completing this course, you should have a basic understanding of the fundamental principles of unsaturated soil mechanics and its application in geotechnical engineering, including an understanding of:

1. definition of unsaturated soils, and identification of scenarios where unsaturated soil mechanics are likely to influence the geotechnical behaviour
2. phases in unsaturated soils, stress state variables, capillarity, surface tension and soil water retention curve
3. measurement of soil suction in the field and laboratory, measurement and fitting of soil water retention and shrinkage curves
4. seepage in unsaturated soils and unsaturated permeability
5. the role of soil suction on shear strength the measurement of unsaturated shear strength
6. plastic and limit equilibrium analyses with a focus on earth pressures, bearing capacity and slope stability
7. the role of soil suction on shear stiffness and unsaturated shear stiffness measurement
8. the application unsaturated soil mechanics on geotechnical and geo-environmental engineering problems, such as slope stability, temporary trench excavations, and landfill cover systems including capillary barriers.

Who should enrol?

This course is ideal if you are:

- a postgraduate student studying towards your Honours Degree in Geotechnical Engineering at the University of Pretoria
- a civil engineering or engineering geology graduate who has completed undergraduate courses in soil mechanics
- a senior engineer interested in improving your knowledge of unsaturated soil mechanics, or
- an engineer who wishes to expand your background in the engineering applications relating to unsaturated soils.

Course fees

R5 000.00 per delegate (VAT incl.) for in-person attendance.
Course fees include all course material, refreshments and meals.

R2 500.00 per delegate (VAT incl.) for online attendance.

R1 125.00 per delegate for online attendance by attendees from Lower-Middle income and Low-Income economies only.
(<https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>)

Course fees must be paid in full 14 days prior to course start dates. Proof of payment can be submitted to enrolments@enterprises.up.ac.za.

Admission requirements

Prospective delegates should ideally hold a degree in civil engineering or engineering geology, with undergraduate knowledge of soil mechanics.

Recommended textbooks

1. Fredlund, D.G., Rahardjo, H. & Fredlund, M.D. (2012). Unsaturated soil mechanics in engineering practice. John Wiley & Sons, Hoboken, New Jersey, pp. 926.
2. Ng, C.W.W. & Menzies, B. (2007). Advanced unsaturated soil mechanics and engineering, Taylor & Francis, Abingdon, Oxon, pp. 687
3. Huat, B.B., Toll, D.G. & Prasad, A. (Eds) (2012). Handbook of tropical residual soils engineering. CRC Press.

Accreditation and certification

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This course is ECSA and SACNASP accredited.

Registration and enquiries

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Course programme

Day 1: Monday 7 February 2022

08:00–10:00	Introduction Mohr circles and stress invariants Stress paths The octahedral plane and triaxial stress space
10:00–10:30	Coffee/Tea break
10:30–12:30	Ideal elastic soil Uncoupled elastic constitutive model Compression of soil Behaviour of soil during shear
12:30–13:30	Lunch
13:30–16:00	The critical state concept The Roscoe surface The Hvorslev surface

Day 2: Tuesday 8 February 2022

08:00–10:00	The behaviour of sand Dilation and the development of a flow rule
10:00–10:30	Coffee/Tea break
10:30–12:30	The Cam Clay model Calculation of elastic and plastic strains

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