



**ALERT Olek Zienkiewicz Summerschool 2017**  
**“Geotechnics of Soft and Organic Soils”**



**Assisi, 26-30 June 2017**

**Course Coordinators:**

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**Venue:**

Palazzo Bernabei, Via San Francesco, 19, 06081 Assisi (PG), Italy

## Course Presentation

All over the world, habitable space in deltas and river areas is under increasing pressure from economic expansion, growing population, subsidence and the impact of climate change. In such environments, the typical geological profile consists of soft to very soft soils, including soft clays, organic clays and peats, which are particularly challenging both from the theoretical and the engineering viewpoint. High compressibility together with relatively high shear strength, anisotropy, time-dependent behaviour, biodegradation of the organic matter are some of the key issues which typically characterise these soils. Geotechnical engineering in these contexts is extremely challenging and requires advanced material behaviour models and analysis tools, to reduce the risk for damage and casualties and improve design and assessment methodologies. The main goal of the course is to provide PhD students and researchers with a comprehensive overview on soft soils mechanics and engineering, as well as an insight into current issues and advanced topics. Both fundamental and applied topics are tackled, during 4.5 days organised with lectures and practical sessions. The course contents include:

### Fundamental Behaviour

The origin of soft and organic soils will be introduced, together with the peculiar aspects in sampling and testing. The phenomenological behaviour of soft natural clays and of organic soils will be systematically presented and discussed.

### Constitutive Modelling

After an introduction recalling the general principles of constitutive modelling of soils, elastic-visco-plastic and hypo-visco-plastic approaches will be specifically addressed for soft, time-dependent soils, at the REV scale.

### Governing Equations: Formulation and Numerical Implementation

The formulation of the coupled hydro-mechanical problem will be presented, in both small- and finite-deformation kinematics, starting from general balance principles and constitutive equations, to cope with both material and geometric non-linearities. Numerical approaches to the solution of the governing equations will be addressed focusing on the Finite Element method. An introduction to the Material Point Method will be provided, with reference to flow-like deformation problems.

### Engineering of Soft Soils

Implementation of soft soil mechanics concepts in engineering practice will be tackled with reference to some of the most relevant geo-technical applications, including foundations, tunnels, slopes, embankments and water defences and reclamation.

### Practical Sessions

Practical sessions are planned to introduce numerical implementation and calibration of constitutive models for soft soils. For the participation to the practical sessions, the students are invited to bring their laptops, and to have a working version of Matlab or Octave available.

## Preliminary Course Program

### Day 1: Fundamental Behaviour

Lecture 1.1. Origin of clays and organic soils, sampling and testing

Lecture 1.2. Behaviour of soft natural clays

Lecture 1.3. Organic soils

Working session 1. Introduction to Octave / Simulation of laboratory tests

### Day 2: Constitutive Modelling

Lecture 2.1. Modelling the behaviour of soils, general principles

Lecture 2.2. Elastic – (visco) – plastic models for soft soils

Lecture 2.3. Hypo – (visco) – plastic models for soft soils

Working session 2. Implementation and calibration of elastic-plastic constitutive models

### Day 3: Modelling and Numerical Implementation

Lecture 3.1. Formulation of coupled hydro-mechanical (consolidation) boundary value problems and Finite Element implementation

Lecture 3.2. Extension to finite kinematics (large deformations)

Lecture 3.3. Compression of lumpy and muddy soils

Lecture 3.4. Numerical modelling of large displacements with MPM

### Day 4: Engineering of Soft Soils 1/2

Lecture 4.1. Tunnelling in soft soils

Lecture 4.2. Embankments on soft soils and ground improvement techniques

Lecture 4.3. Pile foundations in soft soils

Working session 3. Implementation and calibration of elastic-visco-plastic constitutive models

### Day 5: Engineering of Soft Soils 2/2

Lecture 5.1. Fibre reinforcement and soil bonding

Lecture 5.2. Water defences

## Time Table

Day	Time	Activity
Monday 26.06.2017	09:00-10:30	L1.1
	10:30-11:00	Break
	11:00-12:30	L1.2
	12:30-14:00	Lunch break
	14:00-15:30	L1.3
	15:30-16:00	Break
	16:00-17:30	WS1
Tuesday 27.06.2017	09:00-10:30	L2.1
	10:30-11:00	Break
	11:00-12:30	L2.2
	12:30-14:00	Lunch break
	14:00-15:30	L2.3
	15:30-16:00	Break
	16:00-17:30	WS2
Wednesday 28.06.2017	09:00-10:30	L3.1
	10:30-11:00	Break
	11:00-12:30	L3.2
	12:30-14:00	Lunch break
	14:00-15:30	L3.3
	15:30-16:00	Break
	16:00-17:30	L3.4
Thursday 29.06.2017	09:00-10:30	L4.1
	10:30-11:00	Break
	11:00-12:30	L4.2
	12:30-14:00	Lunch break
	14:00-15:30	L4.3
	15:30-16:00	Break
	16:00-17:30	WS3
Friday 30.06.2017	09:00-10:30	L5.1
	10:30-11:00	Break
	11:00-12:30	L5.2