

TIME TABLE

TIME	Monday June 8	Tuesday June 9	Wednesday June 10	Thursday June 11	Friday June 12
9.00 - 9.45	Registration	Muir Wood	Hermann	Pastor	Di Prisco
9.45 - 10.30	Di Prisco	Muir Wood	Hermann	Pastor	Di Prisco
11.00 - 11.45	Triantafyllidis	Muir Wood	Hermann	Pastor	Muir Wood
11.45 - 12.30	Triantafyllidis	Muir Wood	Hermann	Pastor	Di Prisco
14.30 - 15.15	Triantafyllidis	Muir Wood	Hermann	Pastor	
15.15 - 16.00	Triantafyllidis	Di Prisco	Hermann	Pastor	
16.30 - 17.15	Triantafyllidis	Randolph	Randolph	Randolph	
17.15 - 18.00	Triantafyllidis	Randolph	Randolph	Randolph	

ADMISSION AND ACCOMMODATION

Applicants must apply at least one month before the beginning of the course. Application forms should be sent on-line through our web site: <http://www.cism.it> or by post.

A message of confirmation will be sent to accepted participants. If you need assistance for registration please contact our secretariat.

The registration fee is 600,00 Euro.

A limited number of participants from universities and research centres who are not supported by their own institutions can be offered board and/or lodging in a reasonably priced hotel. Requests should be sent to CISM Secretariat by **April 8, 2009** along with the applicant's curriculum and a letter of recommendation by the head of the department or a supervisor confirming that the institute cannot provide funding. Preference will be given to applicants from countries that sponsor CISM.

The Deutscher Akademischer Austausch Dienst (DAAD) and the Deutsche Forschungsgemeinschaft (DFG) offer support to German students. Please contact:

DAAD, Kennedyallee 50, 53175 Bonn
tel. +49 (228) 882-0
e-mail: postmaster@daad.de
web site: <http://www.daad.de/de/kontakt.html>

DFG, Kennedyallee 40, 53175 Bonn
tel. +49 (228) 885 2655
e-mail: ing4@dfg.de
web site: <http://www.dfg.de>

Information about travel and accommodation is available on our web site, or can be mailed upon request.

For further information please contact:

CISM
Palazzo del Torso - Piazza Garibaldi 18
33100 Udine (Italy)
tel. +39 0432 248511 (6 lines)
fax +39 0432 248550
e-mail: cism@cism.it

Centre International des Sciences Mécaniques
International Centre for Mechanical Sciences

ACADEMIC YEAR 2009
The Broglio Session



MECHANICAL BEHAVIOUR OF SOILS UNDER ENVIRONMENTALLY INDUCED CYCLIC LOADS

*Advanced School
coordinated by*

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Italy

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Bristol
UK

Udine, June 8 - 12, 2009

MECHANICAL BEHAVIOUR OF SOILS UNDER ENVIRONMENTALLY INDUCED CYCLIC LOADS

The course aims to provide a comprehensive description of the mechanical response of soils (granular and cohesive materials) under cyclic loading. In particular, environmentally induced cyclic loads (wave motion, wind actions, water table level variation) will be taken into consideration. The engineering problem of reference concerns the evaluation of settlements that can develop with time and their consequences for the serviceability and durability of structures (shallow or deep foundations in offshore engineering, landslide and earth embankment monitoring, caisson breakwaters, ballast and airport pavements etc).

In standard geotechnical practice, even nowadays the designer often faces many difficulties in evaluating the mechanical effects of this type of loading. This is due to the fact that (i) many aspects concerning the mechanical response of soils under cyclic loading characterised by a huge number of cycles are not yet well known, (ii) constitutive models capable of reproducing such a response are sophisticated and complex for the end user, (iii) the computational time required is often substantial. To clarify and put in order the theoretical framework of reference, by taking into consideration the

most recent and novel research results, this course will outline a path starting from micromechanics and arriving at the analysis of boundary value problems. The subject will be approached by discussing experimental, theoretical, numerical and computational aspects. Shake down, ratcheting and progressive failure phenomena will be described through experimental observation and theoretical analysis and also explored from a micro-structural point of view. Both cohesive and frictional materials, both drained and undrained conditions will be taken into consideration.

Coupling effects due to the presence of fluids within pores will be presented and hydro-mechanical aspects discussed. Different classes of constitutive modelling theories will be described including: standard non-associated elasto-plastic constitutive models characterised by anisotropic strain hardening rules; generalised plasticity; bounding surface plasticity. Boundary value problems will be tackled in order to demonstrate and quantify the consequences of the choice of the constitutive model on the numerical analysis results.

PRELIMINARY SUGGESTED READINGS

O'Reilly, M.P.O. and Brown, S.F. "Cyclic Loading of Soils". (1991), Blackie and Son Ltd.

K. Ishihara "Soil Behaviour in Earthquake Geotechnics". (1995), Oxford Science Publications.

S. L. Kramer "Geotechnical, Earthquake Engineering". (1996), Prentice Hall.

O.C. Zienkiewicz, A.H. Chan, M. Pastor, B. Schrefler and T. Shiomi "Computational Geomechanics". (1999), John Wiley, and Sons.

B. Cambou & C. di Prisco (Eds), "Constitutive Modelling of Geomaterials". (2000), Hermes.

M. Pastor and C. Tamagnini, (Eds) "Numerical Modelling of Geomaterials". (2002) Hermes.

D. Muir Wood "Geotechnical modelling". (2004), Taylor&Francis.

I. Towhata "Geotechnical Earthquake, Engineering". (2008), Springer.

INVITED LECTURERS

Claudio Giulio di Prisco - Politecnico di Milano, Italy
5 lectures on: Introduction. Constitutive modelling: Multi-mechanism elasto-plastic approaches Simplified stress-path method. Macro-element modelling: the theory of macro-element for shallow footings and pipelines.

Hans Herrmann - ETH, Zurich, Switzerland
6 lectures on: Discrete Element Modelling: simulations of soils with DEM, concerning shear banding, ratcheting, fluid erosion, compaction and vibration.

David Muir Wood - University of Bristol, UK
6 lectures on: Constitutive modelling: Elastic-plastic modelling. Asymptotic states. Kinematic hardening, bounding surface strainbased models. Macroelement modelling: Macroelements for gravity wall and soil-structure interaction.

Manuel Pastor - Universidad Politecnica de Madrid, Spain
6 lectures on: Mathematical modelling. Hyperbolic problems: alternative formulations. Numerical modelling: introduction to finite differences and finite elements in solid dynamics. Analysis of stability, numerical diffusion and dispersion. Alternative coupled formulations in soil dynamics. Applications to ocean and earthquake engineering.

Mark Randolph - University of Western Australia, Perth
6 lectures on: Physical modelling and design: Laboratory and field evaluation of the remoulded shear strength of offshore clays. Assessment of cyclic pipeline-soil and riser-soil interactions. Offshore design approaches for pre-failure cyclic loading of foundations. Model tests exploring foundation response under cyclic loading. Cyclic interface tests on sand and the influence of cyclic shearing on axial pile capacity in sand. Cyclic interface response of cemented calcareous sediments and resulting axial capacity of grouted piles.

Theodor Triantafyllidis - University of Karlsruhe, Germany
6 lectures on: Experimental observations. Small strain stiffness: resonant Column and Bender Element Tests Triaxial testing with polycyclic loading in drained and undrained conditions. Liquefaction due to cyclic loading in strain and stress controlled conditions. Correlations with in situ tests.

LECTURES

All lectures will be given in English. Lecture notes can be downloaded from CISM web site, instructions will be sent to accepted participants.

**MECHANICAL BEHAVIOUR OF SOILS
UNDER ENVIRONMENTALLY INDUCED CYCLIC LOADS**

Udine, June 8 - 12, 2009

Application Form

(Please print or type)

Surname _____

Name _____

Affiliation _____

Address _____

E-mail _____

Phone _____ Fax _____

Method of payment upon receipt of confirmation (Please check the box)

The fee of Euro 600,00 includes IVA/VAT tax and excludes bank charges

I shall send a check of Euro _____

Payment will be made to CISM - Bank Account N° 094570210900,
VENETO BANCA - Udine (CAB 12300 - ABI 05418 - SWIFT AMBPIT2M - IBAN
CODE IT83Z 05418 12300 09457 0210900).

Copy of the receipt should be sent to the secretariat

I shall pay at the registration counter with check, cash or VISA
Credit Card (Mastercard/Eurocard, Visa, CartaSi)

IMPORTANT: CISM is obliged to present an invoice for the above sum. Please indicate to whom the invoice should be addressed.

Name _____

Address _____

C.F.* _____

VAT/IVA* No. _____

(*) Only for EU residents or foreigners with a permanent business activity in Italy.

Only for Italian Public Companies

I ask for IVA exemption (ex law n. 537/1993 - art. 14 comma 10).

Privacy policy: I understand that data received via this form will be used only to provide information about CISM and its activities, within the limits set by the Italian legislative decree no. 196/2003 and subsequent amendments.

Complete information on CISM's privacy policy is available at www.cism.it.

I have read the "Admission and Accommodation" terms and conditions and agree.

Date _____ Signature _____