ROSE School

The ROSE School Master's in Earthquake Engineering

Geotechnical Earthquake Engineering

Lecturers: **N. Ntritsos**
Date: 11/01/2027 – 22/01/2027
Semester: Second
Credits: 3 ECTS (CFU)

Course Description

This short course introduces the fundamental theories and methods of geotechnical earthquake engineering and soil dynamics, aiming to equip students with the essential tools to understand, model and assess the behaviour of soils and soil-structure systems during earthquakes. The course combines lectures – focusing on fundamental concepts of soil behaviour under seismic loading and related problems – with tutorial sessions emphasizing practical engineering applications and problem solving. All topics are illustrated through well-documented case histories, using field observations of the performance of land, buildings and infrastructure during major earthquakes.

Topics

- Soil behaviour under earthquake loading: propagation of elastic waves in layered solids; fundamentals of soil behaviour under cyclic loading; geotechnical characterization through in-situ and laboratory testing.
- Site effects and ground response analysis: evidence from case histories, prediction of site effects, one-dimensional equivalent-linear and nonlinear analyses, overview of two-dimensional effects.
- Engineering evaluation of soil liquefaction: susceptibility, triggering and consequences of liquefaction; simplified and advanced analysis methods; mitigation approaches.
- Seismic assessment of slopes and embankments: mechanisms of earthquake-induced landslides, geological and geomorphological factors; analysis methods including pseudostatic, sliding block, stress–deformation methods.
- Seismic soil-structure interaction (SSI): principles of SSI, inertial & kinematic interaction; foundation impedance; modelling and analysis approaches (substructure and direct methods), consideration of SSI in design practice.

Learning Outcomes

On completion of this course, students will be able to:

- Understand and explain the primary mechanisms by which seismic waves interact with soils, and interpret the behaviour of soils and geotechnical structures during earthquakes.
- Describe the ways in which local site effects influence ground motion and perform, or critically interpret, basic one-dimensional ground response analysis.
- Recognize the conditions under which soil liquefaction may occur and evaluate its effects on land and engineering structures using simplified, state-of-the-practice procedures.

- Identify the main factors contributing to earthquake-induced slope instability and apply simplified methods for evaluating seismic slope stability.
- Explain the general principles of soil–structure interaction and the role of soil in the seismic performance of structures; employ structural analysis procedures incorporating SSI.
- Critically appraise geotechnical seismic assessment results with awareness of their assumptions and limitations.

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