ROSE School | Earthquake Engineering

Fundamentals of Seismic Design

Lecturer: **R. Monteiro**
Date: 11/06/2026 – 10/07/2026
Credits: 6 ECTS (CFU)

Course Description

The course starts with a brief review on the main aspects of the dynamic behaviour of linear and nonlinear single-degree-of-freedom systems and characterisation of the force-deformation behaviour of reinforced concrete structural elements, which represent the basis to understand seismic design. Afterwards, the conceptual seismic design of structures will be addressed. The core of the course will be the discussion of (largely enforced) force-based and (developing) displacement-based seismic design philosophies, focusing on the tools and steps required for their employment and verification. Capacity design principles, necessary to ensure a target hierarchy of ductile inelastic deformations will be explained with emphasis on the design and detailing of reinforced concrete structures with the adoption of Eurocode 8, amongst other codes and guidelines. Four homework assignments are foreseen, which will address the characterisation of the seismic input and the seismic design and detailing of a reinforced concrete building with structural walls.

Topics

- Force-deformation characteristics of RC elements.
- Elastic and inelastic response spectra.
- Seismic analysis and design methods.
- Force-based design methods.
- Equivalent lateral force method.
- Response spectrum method.
- Considerations on force-based seismic design.
- Direct displacement-based seismic design (DDBD).
- Introduction to seismic design and performance of non-structural elements.
- Capacity design, introduction and principles.
- Code-based capacity design steps.
- Section detailing.
- Conceptual seismic design.
- Design verification and introduction to retrofitting.

Upon successful completion of this course, students will be able to:

- Understand the linear and nonlinear capacity characterisation of RC members.

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- Define and use seismic demand from a design perspective.
- Apply different force-based seismic design procedures.
- Understand and carry out displacement-based seismic design, and compare it with force-based seismic design.
- Implement capacity-design principles and code-based section and member detailing rules.