Escola de Camins
Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports
UPC BARCELONATECH

UPC

Università degli Studi di Palermo

dipartimento di ingegneria
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WINTER SCHOOL

Introduction to OpenSees for Seismic Analysis of Structures

January 27-28-29 and February 3-4-5, 2026, 09:00-13:00 CEST (24 hours)

In-person course at ETSECCPB, Campus Nord UPC, Barcelona

FREE for students currently enrolled at UPC (PhD Candidates and Master Students)
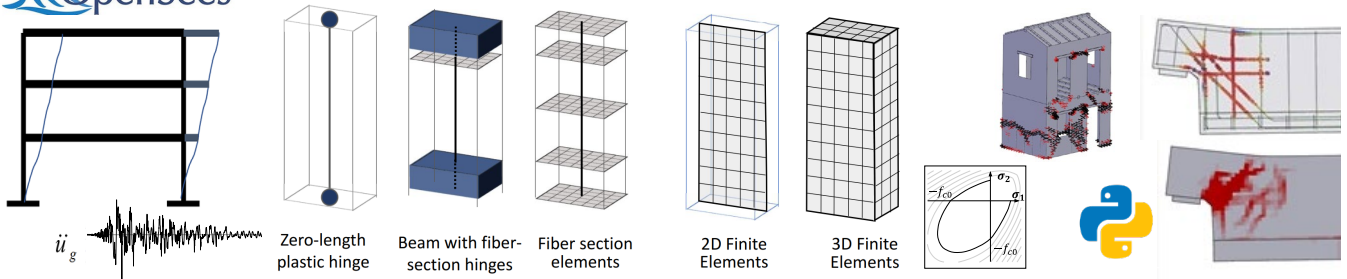
Lecturers:

Prof. Fabio Di Trapani, University of Palermo, Italy (fabio.ditrapani@unipa.it)
Eng. Sofia Villar, PhD Candidate, Politecnico di Torino, Italy (sofia.villar@polito.it)

Organizers:

Prof. Luca Pelà and Dr. Larisa Garcia-Ramonda, ETSECCPB, UPC-BarcelonaTech
(luca.pela@upc.edu, larisa.garcia.ramonda@upc.edu)

OpenSees

$\ddot{u}_g$ Zero-length plastic hinge   Beam with fiber-section hinges   Fiber section elements   2D Finite Elements   3D Finite Elements σ_2 σ_1 $-f_{c0}$

About the course

This is an intensive course that introduces students to **OpenSees** (Open System for Earthquake Engineering Simulation), with a focus on its Python interface, **OpenSeesPy**, for modeling and analyzing structural systems under static, cyclic, and dynamic loads.

The course blends theoretical instruction with hands-on implementation, guiding students through the full modeling workflow from basic linear structures to advanced nonlinear simulations using both concentrated and distributed plasticity approaches. Special emphasis is placed on modern research applications and practical tools such as **ASDEA STKO** software platform for pre/post-processing. Through interactive lectures, live workshops, and project-based learning, students will gain practical skills in building and analyzing structural models suitable for academic research and professional applications.

Aim

The course aims to equip doctoral students with both the **theoretical understanding and practical skills** necessary to use OpenSeesPy for advanced structural analysis. By the end of the course, students will be able to create, simulate, interpret complex structural models, and apply these capabilities to cutting-edge research in earthquake engineering, structural performance assessment, and retrofit design.

For more information please send an email to: luca.pela@upc.edu

Program

Week 1 (12 h) - Classroom C1-001, 09:00-13:00 CEST

| Day 1 27/01	- **Lecture (2.5 h):** Brief introduction to Python and TCL (interpreters and IDEs) and overview of OpenSeesPy. Linear analysis of 2D and 3D structures. - **Exercise & Live Workshop (1.5 h):** Implementation of a simple 2D linear structure in OpenSees
Day 2 28/01	- **Lecture (2.5 h):** Nonlinear analysis of frame structures using concentrated plasticity approach - **Exercise & Live Workshop (1.5 h):** Model implementation with flexural and shear plastic hinges and nonlinear static monotonic and cyclic analysis
Day 3 29/01	- **Lecture (3 h):** Nonlinear static analysis of frame structures using distributed plasticity approach: Formulation of force-based and displacement-based fiber section elements. - **Exercise & Live Workshop (1h):** Model implementation with distributed plasticity approach: Modeling of steel members and RC members with monotonic and cyclic loads.

Week 2 (12 h) - Days 1-3 classroom C1-001, day 2 classroom B1-002, 09:00-13:00 CEST

Day 1 03/02	- **Lecture (2.5 h):** Nonlinear dynamic analysis of frame structures. - **Exercise & Live Workshop (1.5 h):** Modal analysis and linear / nonlinear time history analysis of sample frame structures.
Day 2 04/02	- **Lecture (2.5 h):** Introduction to STKO framework - **Exercise & Live Workshop (1.5 h):** Numerical modelling and analysis of 1D frame structures. Pre and post processing tools.
Day 3 05/02	- **Lecture (2.5 h):** Introduction to 3D materials for high-fidelity modelling - **Exercise & Live Workshop (1.5 h):** Implementation in 2D and 3D numerical models for reinforced concrete and masonry structures.

Short CV of the lecturers
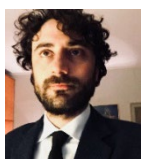
Prof. Fabio Di Trapani is Associate Professor of Structural Engineering at the University of Palermo, Italy, with prior appointment as Assistant Professor at Politecnico di Torino. His research focuses on seismic performance, modeling, and retrofitting of reinforced concrete and masonry structures, with a strong emphasis on nonlinear analysis and optimization techniques. He is principal investigator or unit coordinator in several national and EU-funded projects (RELUIS, PRIN, Horizon Europe), covering topics such as AI-driven seismic retrofit optimization, structural monitoring, and performance modeling of complex masonry systems. He has supervised multiple PhD theses and regularly teaches doctoral-level courses on nonlinear seismic analysis and structural simulation. Prof. Di Trapani has authored over 80 publications in top-tier journals (e.g., *Engineering Structures*, *Journal of Structural Engineering*, *Bulletin of Earthquake Engineering*) and serves on editorial boards including *Earthquake and Structures* and *Computers and Concrete*. He is also a frequent lecturer in international OpenSees short courses and has delivered invited talks at UCL, UC San Diego, Fuzhou University, and EPFL.
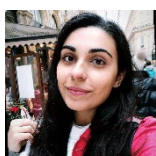
Eng. Sofia Villar is PhD candidate at Politecnico di Torino, and currently visiting PhD researcher at UPC-BarcelonaTech. Her PhD research focuses on high fidelity numerical modelling and seismic assessment of large masonry structures. She has expertise in 2D and 3D modelling of brittle materials using OpenSees and STKO.

For more information please send an email to: luca.pela@upc.edu