ROSE
Centre for Training and Research on Reduction of Seismic Risk

IUSS
Scuola Universitaria Superiore Pavia

Course Title: **Performance-Based Earthquake Engineering**
Lecturer: Gerard J. O'Reilly
Dates: 25th October – 10th November 2023
Hours: 37 hours (27 lectures + 10 tutorials)
Location: Palazzo del Broletto, Piazza della Vittoria 15, Pavia

Description

This course covers topics related to performance-based earthquake engineering (PBEE) of new and existing buildings. A quick background on the development of PBEE is first provided, outlining its early beginnings, followed by the notable developments in the past 25 years that have led to the current and avant-garde approaches available in the literature. This relates to the design and assessment of buildings, particularly those commonly found in Italy and Southern Europe. The course focuses on the ingredients necessary for quantifying uncertainties, calculating risk, and estimating economic losses. Advanced topics such as risk- and loss-targeted seismic design methods are presented in addition to both simplified and extensive risk assessment methods available to practitioners. Other issues relating to ground motion and intensity measure selection to characterise seismic response are also covered. The course aims to provide students who are already familiar with current building codes and other standard seismic analysis methods with a better understanding of these advanced topics and state-of-the-art methods available within modern PBEE.

Grading

Coursework 40%
Final exam 60%

Schedule

Date	Time	Topic	Classroom
26th Oct	09:00 – 12:00	**1. Course Overview** **2. Analysis Methods - Part I** • Non-linear static analysis • Non-linear dynamic analysis • MDOF vs SDOF models • Incremental dynamic analysis (IDA)	Aula 1-17
	14:00 – 17:00	**3. Seismic Risk - Part I** • Seismic hazard, logic trees and disaggregation • Fragility functions (FFs) • Derivation of FFs from IDA • Calculation of risk	Aula 1-17
27th Oct	09:00 – 12:00	**4. Analysis Methods – Part II** • Cloud analysis (CA) • Multiple stripe analysis (MSA) • Derivation of FFs from CA and MSA • Simplified analysis methods	Aula 1-17
	14:00 – 16:00	Tutorial: Part 1 - Identification of case study building and site hazard	Aula 1-17
30th Oct	09:00 – 12:00	**5. Intensity Measures (IMs)** • Traditional definitions and novel developments • IM choice – efficiency, sufficiency, practicality • Potential bias in structural response • Ground motion record scaling	Aula 1-15
	14:00 – 16:00	Tutorial: Part 2 - Static pushover and modal analysis	Aula 1-15
31st Oct	09:00 – 12:00	**7. Seismic Risk - Part II** • Demand-intensity models • Sources of uncertainty	Aula 1-15

		• Demand-hazard curves	
	14:00 – 16:00	Tutorial: Part 3 - Incremental dynamic analysis	Aula 1-16
2nd Nov	09:00 – 12:00	**6. Ground Motion Record Selection** • Code-based selection • Hazard-consistency • Conditional spectrum • Generalised conditional intensity measure (GCIM) • Scenario-based analysis and spatial correlation	Aula 1-17
	14:00 – 16:00	Tutorial: Part 4 - Identification of ground motion records	Aula 1-17
3rd Nov	09:00 – 12:00	**8. Loss and Risk Assessment** • Overview of loss assessment • Storey loss function-based assessment • Simplified risk assessment	Aula 1-17
	14:00 – 16:00	Tutorial: Part 5 - Multiple stripe analysis	Aula 1-17
6th Nov	09:00 – 11:00	Tutorial: Part 6 - Economic loss and collapse risk	Aula 1-16
	14:00 – 17:00	**9. Risk (and Loss)-Targeted Design** • Risk-targeted spectra • Risk-targeted behaviour factors • Yield-frequency spectra • Integrated performance-based seismic design	Aula 1-15
7th Nov	09:00 – 12:00	**10. Typology-Specific Issues** • Infilled frame structures • Unreinforced masonry structures	Aula 1-17
8th Nov	09:00 – 12:00	**11. Future Directions** • Downtime and functional recovery • Indirect losses	Aula 1-17
10th Nov	09:00 – 12:00	**Final Exam**	Aula 1-17