ROSE
CENTRE FOR TRAINING AND
RESEARCH ON REDUCTION
OF SEISMIC RISK

IUSS
Scuola Universitaria Superiore Pavia

Course Title:	**Performance-Based Earthquake Engineering – 2024/2025**
Lecturer:	Gerard J. O'Reilly
Dates:	05/02/2025 – 20/02/2025
Hours:	48 hours (30 lectures + 18 tutorials)
Location:	Palazzo del Broletto, Piazza della Vittoria 15, Pavia, Italy

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 regional assessment, 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
Wed 05/02	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)	
	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	
Thur 06/02	09:00 – 12:00	**4. Ground Motion Record Selection** • Code-based selection • Hazard-consistency • Conditional spectrum • Generalised conditional intensity measure (GCIM) •	
	14:00 – 17:00	Tutorial: Part 1 - Identification of case study building and site hazard Part 2 - Identification of ground motion records	
Fri 07/02	09:00 – 12:00	**5. Analysis Methods – Part II** • Cloud analysis (CA) • Multiple stripe analysis (MSA) • Derivation of FFs from CA and MSA • Simplified analysis methods	
	14:00 – 17:00	Tutorial: Part 3 - Multiple stripe analysis	

Mon 10/02	09:00 – 12:00	**6. Intensity Measures (IMs)** • Traditional definitions and novel developments • IM choice – efficiency, sufficiency, practicality • Potential bias in structural response • Ground motion record scaling	
	14:00 – 17:00	Tutorial: Part 4 - Incremental dynamic analysis	
Tue 11/02	09:00 – 12:00	**7. Seismic Risk - Part II** • Demand-intensity models • Sources of uncertainty • Demand-hazard curves	
	14:00 – 17:00	Tutorial: Part 5 – Calculation of risk	
Wed 12/02	09:00 – 12:00	**8. Loss and Risk Assessment** • Overview of loss assessment • Storey loss function-based assessment • Simplified risk assessment	
	14:00 – 17:00	Tutorial: Part 6 - Economic loss	
Thur 13/02	09:00 – 12:00	**9. Risk (and Loss)-Targeted Design** • Risk-targeted spectra • Risk-targeted behaviour factors • Yield-frequency spectra • Integrated performance-based seismic design	
	14:00 – 17:00	Tutorial: Part 7 – Risk-targeted design	
Mon 17/02	09:00 – 12:00	**10. Regional risk assessment** • Scenario-based analysis • Incorporating correlations (spatial, Inter- and intra-structure) • Taxonomies classification and fragility functions • Generating ground shaking and risk maps	
Tue 18/02	09:00 – 12:00	**11. Future Directions** • Downtime and functional recovery • Indirect losses **12. Typology-Specific Issues** • Infilled frame structures • Unreinforced masonry structures	
Thur 20/02	**09:00 – 13:00**	**Final Exam**	