

Civil Engineering for Mitigation of Risk from Natural Hazards

Course: Seismic Risk Assessment

a.y.: 2024-2025

Lecturers: Prof. Paolo Bazzurro, Prof. Dimitrios Vamvatsikos, Dr. Mohsen Kohrangi

Teaching Assistant: Alessandro Damiani

Date: 24/09/2025 – 20/10/2025

Classrooms at Broletto (Piazza della Vittoria 15): See timetable below for more details

Course schedule

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Overview of the course

This course comprises three distinct but well-connected parts. The main focus of the course is on seismic risk but it will also deal with risk assessment for other perils.

This course will start with a very succinct overview of the basics of probability and statistics that are commonly used in the field of hazard and risk assessment. The knowledge of the subject is a pre-requisite of the course. After this preamble, in the first part (weeks 1 and 2) we will move on to describe the basics of risk assessment and loss estimation for assets subject to natural events such as earthquakes and tropical cyclones. In this part we will also review the fundamentals of seismic hazard analysis and we will cover both probabilistic and deterministic approaches. Then we will deal with the theory behind catastrophe risk modeling of portfolios of structures mostly for earthquakes but will briefly discuss tropical cyclones as well. The applications discussed are typical of those found in the insurance/reinsurance industry, capital markets, and sovereign disaster risk financing. Therefore, some fundamentals of insurance/reinsurance will also be provided. Then we will introduce the concepts of seismic risk for single structures and we will compare and contrast them with the approach for portfolio of assets. Time permitting, we will discuss the risk assessment of networks and of nuclear power plants. These cases have special aspects that are not found in the previous applications discussed during the course.

The second part of the course (week 3) will tackle in detail the state-of-the art approach to assess seismic risk of single buildings for both collapse and loss estimation purposes. The techniques that you will learn here are applicable both to the design of new buildings and to the assessment of existing ones.

Finally the third and last part (week 4) will focus on the application of the portfolio seismic risk assessment theory to real case studies. In this part you will be using models already built and the emphasis will be in learning how to compute and interpret correctly their results.