University of Pavia

IUSS School of Advanced Studies

Civil Engineering for Mitigation of Risk from Natural Hazards

Course: Seismic Risk
a.y.: 2020/2021
Lecturer: Prof. Paolo Bazzurro, Prof. Dimitrios Vamvatsikos, Prof. Mario Ordaz
Teaching Assistant: Nevena Šipčić
Date: 21/09/2020 – 19/10/2020
Classroom: IUSS (See time schedule below for more details)

Course schedule

Week	Classroom	Date	Lecture hours	Tutorial hours	Subject	Tot
			From____To____	From____To____		h
1		21/09/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
		22/09/2020				
		23/09/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
		24/09/2020				2
			15.30 – 17.30		Risk Assessment: theory	
		25/09/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
2		28/09/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
		29/09/2020			Risk Assessment: theory	
		30/09/2020			Risk Assessment: theory	
		01/10/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
		02/10/2020	10.00 – 12.00		Risk Assessment: theory	4
			14.00 – 16.00			
3		05/10/2020	10.30 – 12.30		single building earthquake risk assessment	6
			14.00 – 16.00	16.00 – 18.00		
		06/10/2020	10.30 – 12.30		single building earthquake risk assessment	6
			14.00 – 16.00	16.00 – 18.00		
		07/10/2020	10.30 – 12.30		single building earthquake risk assessment	6
			14.00 – 16.00	16.00 – 18.00		
		08/10/2020	10.30 – 12.30		single building earthquake risk assessment	6
			14.00 – 16.00	16.00 – 18.00		
		09/10/2020	10.30 – 12.30		single building earthquake risk assessment	2
4		12/10/2020	16:00 - 19:00		Theoretical aspects of risk	3
		13/10/2020	16:00 - 18:00		Risk due to specific perils: Tsunami, Volcano, Rainfall-Flood	2
		14/10/2020	16:00 - 18:00		Multihazard risk evaluation: theory of peril-agnostic systems	2
			18:00 - 19:00		CAPRA: A tool for multihazard risk evaluation	1
		15/10/2020		16:00 - 17:00	Final project. Introduction and discussion	1
				17:00 - 18:00	Practical risk calculation	1
		16/10/2020		16:00 - 18:00	Practical risk calculation and interpretation of results. Discussion on final project	2
5		19/10/2020	9:00-11:30	**Final Exam**		2,5
		20/10/2020	15:00 - 18:00	**Final multi-hazard risk assessment project presentation**		1,5
		21/10/2020				
		22/10/2020				
		23/10/2020				

Overview of the course

This course comprises three distinct but well-connected parts. The main focus of the course is on seismic risk but, despite its official title, 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. Working knowledge of probability and statistics is a pre-requisite of the course. After this preamble, in the first part 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 both for earthquakes and for tropical cyclones. The examples 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 (a topic that will be tackled in the second part of the course) 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 applications previously discussed during the course.

The second part of the course 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 of the course after a brief recap on the theoretical aspects of risk calculations will provide an overview of risk assessment of other perils, such as volcanic eruptions, tsunamis, hail and rain. Then the focus will shift to applications of the multi-hazard portfolio loss assessment with emphasis on the correct interpretation of their results.