



# Civil Engineering for Mitigation of Risk from Natural Hazards

**Course: Foundation Engineering and Earth Retaining Structures**

a.y.: 2021 - 2022

Lecturer: Prof. Dr. Giovanni Cascante

Date: March 7 to April 1, 2022

Classroom:

## Course schedule

Week	Date	Lecture hours From 9:30 to 12:30	Tutorial hours From 14:30 to 16:30	Subject	Tot h
1	07/03	✓	✓	<b>I. Soil mechanics review</b> Fundamentals of soil behaviour; site characterization: laboratory and in situ tests	4.5
	08/03				
	09/03	✓	✓	Introduction to Eurocode 7 and limit states (SLS – ULS)	4.5
	10/03				
	11/03	✓	✓	<b>II. Shallow foundations</b> Bearing Capacity of Foundations, Foundation Settlements	4.5
2	14/03	✓	✓	Factors to Consider in Foundation Design, Spread Footing analysis and design. Application of EC7, ULS and SLS	4.5
	15/03				
	16/03	✓	✓	Beam, Grid and Mat Foundations Soil-Foundation-Structure Interaction	4.5
	17/03				
	18/03	✓	✓	Beams on Elastic Foundations (Soil-structure interaction using Winkler Foundation)	4.5
3	21/03	✓	✓	<b>III. Introduction to pile foundations</b> Single Piles – Static Capacity and Lateral Loads	4.5
	22/03				
	23/03	✓	✓	Piled Foundations: Groups. Analysis and design.	4.5
	24/03				
	25/03			<b>IV. Earth retaining structures</b> Lateral Earth Pressure	4.5
4	28/03	✓	✓	Rigid Earth Retaining Systems	4.5
	29/03				
	30/03	✓	✓	Flexible Earth Retaining Systems	4.5
	31/03				
	1/04	✓	✓	<b>Open discussion and revisions</b>	4.5

**Textbooks:**

- Geotechnical Engineering, 2<sup>nd</sup> ed., Renato Lancellotta, Spon Text, 2008
- Foundation Analysis and Design, Joseph E. Bowles, McGraw-Hill, 1997
- Piles and Pile Foundations, Carlo Viggiani – Alessandro Mandolini – Gianpiero Russo, Spon Press, 2011
- Eurocode 7: Geotechnical Design Worked examples, European Commission, Joint Research Centre, Institute for the Protection and Security of the Citizen, ISBN 978-92-79-33759-8, ISSN 1831-9424, doi: 10.2788/3398

**Objectives:** The purpose of this course is to apply the principles of soil mechanics to the analysis and design of foundation systems and earth retaining structures.

**Description:** Review on physical and engineering properties of soils of principal interest for the analysis and design of foundation elements shall be considered at the beginning of the course.

Geotechnical Design and main aspects of performance-based design will also be addressed, introducing the concepts of Service Limit State and Ultimate Limit State.

The load capacity and movements of shallow and deep foundations will be studied. Evaluation of the limiting shear resistance, or ultimate bearing capacity of the soil under a foundation load together with estimation of the settlements will be presented. Soil-structure-Interaction will be introduced using Winkler type foundation. Concept, design, and construction of different type of shallow foundations shall be discussed by various engineering examples. Particular attention will be paid on application of EC7 for problem – analysis and design (ULS and SLS) of shallow foundations. Static pile capacity determination as well as an introduction to materials and methods to produce pile members will be discussed. Methods to analyze lateral pile response to loads will also be presented. Ultimate pile capacity, settlements for pile and pile groups will be discussed. Analysis and design of single pile as well as pile groups using EC7 guidelines will be presented. Theoretical background of the lateral earth pressure problem will be discussed (active and passive earth pressure, seismic earth pressure). The basic principles for analysis and design of the reinforced earth, gravity, and concrete cantilever wall; the sheet-pile cantilever and anchored walls will be considered. Analysis of sliding, overturning and rotational wall stability. Practical engineering examples on retaining structures using EC7 analysis and design recommendations will be given.

**Assignments:** Homework assignments will be assigned each week. Student may help one another with homework but each student must hand in his or her own work.

**Exam:** Final exam will be given. Exam is closed note, closed book, and no phones or other electronic devices will be allowed besides your calculator (if needed).

**Grade Breakdown**

- *Homework assignments 30%*
- *Exam 65%*
- *Class Participation 5%*