

Course Unit	Design in Geotechnical Engineering		Field of study	Solid Mechanics and Structures	
Master in	Construction Engineering		School	School of Technology and Management	
Academic Year	2023/2024	Year of study	1	Level	2-1
Type	Semestral	Semester	1	ECTS credits	6.0
Code	5024-419-1104-00-23				
Workload (hours)	162	Contact hours	T -	TP 60	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) António Miguel Verdelho Paula

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Know the European legislation and methodologies for safety assessment in geotechnical work. Eurocode 7.
2. Calculate the safe bearing capacity of soils. Estimate the settlement of shallow foundations. Estimate the size of shallow foundations to satisfy bearing capacity and settlement criteria.
3. Determine the allowable axial load capacity of single piles and pile groups. Determine the settlement of single piles and pile groups.
4. To appreciate that an earth structure can comprise a variety of material types each performing a different function.
5. Understand and determine lateral earth pressures. Understand the forces that lead to instability of earth retaining structures.
6. Determine the stability of earth retaining structures. To be aware of the range and styles of walls in various applications.
7. Determine the internal and external stability of a reinforced soil structure.

### Prerequisites

Before the course unit the learner is expected to be able to:

1. Determine the shear strength of soils.
2. Understand the differences between drained and undrained shear strength.
3. Know the shear strength parameters of soils.
4. Calculate stresses and strains in soils from external loads.

### Course contents

General criteria for the geotechnical design. Eurocode 7. Shallow foundations and pile foundations. Stability of earth retaining structures.

### Course contents (extended version)

1. General criteria for the geotechnical design. Eurocode 7.
  - Basis of geotechnical design, situations requirements, geotechnical design by calculation.
  - Evaluation of geotechnical parameters, procedure for evaluating geotechnical parameters.
  - Supervision of construction, monitoring and maintenance.
2. Shallow foundations.
  - Collapse load Using the limit equilibrium method. Bearing Capacity Equations.
  - Mat foundations. Bearing capacity of layered soils.
  - Building codes bearing capacity values. Settlement calculations.
  - Immediate settlement. Primary consolidation settlement.
  - Determination of bearing capacity and settlement of coarse-grained soils from field tests.
  - Horizontal elastic displacement and rotation.
3. Pile foundations.
  - Type of piles and installations. Concrete piles. Steel piles. Timber Piles. Pile installation.
  - Load capacity of single piles. Pile load test. Pile load capacity based on SPT and CPT.
  - Pile groups. Elastic settlement of piles. Consolidation settlement under a pile group.
  - Procedure to estimate settlement of single and group piles.
  - Piles subjected to negative skin friction. Laterally loaded piles.
4. Stability of earth retaining structures.
  - Lateral earth pressures. Lateral earth pressure for a total stress analysis.
  - Application of lateral earth pressures to retaining walls.
  - Types of retaining walls and modes of failure. Stability of rigid retaining walls.
  - Stability of flexible retaining walls. Methods of analyses. Analysis of cantilever sheet pile walls.
  - Anchored sheet pile walls. Mechanical stabilized earth walls. Other types of retaining walls.

### Recommended reading

1. EUROCÓDIGO 7 – Parte 1: , 1994. Projeto Geotécnico. Regras Gerais. Pré-norma europeia, ENV 1997-1: 1995 PT. Comissão Europeia de Normalizações, Bruxelas.
2. CODUTO, D. P. (2001). "Foundation Design: Principles and Practices". Prentice-Hall, Inc. , New Jersey.
3. POULOS, H. G. & DAVIS, E. H. (1980). "Pile Foundation Analysis and Design". John Wiley and Sons, Geotechnical Engineering Series, Singapore.
4. Guia de Dimensionamento de Fundações: Governo de Macau-Direção dos Serviços de Solos Obras Publicas e Transportes.

### Teaching and learning methods

Theory and practical lectures, will help the student later in their career to address unconventional issues using fundamental principles. Problem solving, apply the fundamental principles and concepts to a wide variety of problems, these problems will test the student understanding and use of the fundamental principles and concepts.

### Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
  - Intermediate Written Test - 50% (Chapter 1 and 2. Theoretical Test (5 Value) and Practical Test (5 Value).)
  - Intermediate Written Test - 50% (Chapter 3 and 4. Theoretical Test (5 Value) and Practical Test (5 Value).)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
  - Final Written Exam - 100% (Theoretical Test (10 Value) and Practical Test (10 Value).)

**Language of instruction**

Portuguese, with additional English support for foreign students.

**Electronic validation**

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03-10-2023	04-10-2023	04-10-2023	10-10-2023