

Course	<b>Master Civil Constructions</b>			Academic year	2020-2021		
Subject	<b>Works of Excavation and Containment</b>			ECTS	6		
Type of course	<b>Compulsory</b>						
Year	<b>1st</b>	Semester	<b>1st</b>	Student Workload:			
Professor(s)	<b>Carlos Rodrigues</b>			Total	168	Contact	52,5
Area disciplinary Coordinator	<b>José Carlos Almeida</b>						

**Planned**

## 1. LEARNING OBJECTIVES

### Goal:

Imparting knowledge in the field of design of excavation and retaining structures for the soils.  
Deepen the knowledge in the retaining structures, especially in the area of rigid support structures.  
Present knowledge of the behaviour of flexible support structures. Calculation methods, safety analysis of pre-sizing and constructive recommendations.  
Introduce the principles of design of retaining structures and excavations by the EC7.

### Skills:

Acquisition of the concepts related to the design and principles of design of various types of structures.  
Understanding the phenomena related to mobilization of the ultimate limit state and serviceability.  
Capacity to define the characteristic values for geotechnical properties, for actions and resistances.  
Applications of the design methodologies proposed by the EC7.

## 2. PROGRAMME

Opencast excavations: ditches stability and safety.  
Underground excavations: tunnels notions, excavation works.  
Flexible earth retaining structures: earth pressures, water pressures and surcharges, arc effect in soils; bottom stability.  
Conception, design, stability analysis, constructive aspects, strut and anchorages.  
Internally stabilized support structures, soil reinforcement, kinds of reinforcement for retaining structures.  
Nailing and nailed excavations.  
Instrumentation and observation of geotechnical works.  
Practical case studies.

## 3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

Established syllabus allows the students to develop skills in the understanding of the retaining structures behaviour and excavations regarding the EC-7. Introduction of different materials allows the students to have the basis to proceed with the design of retaining structures and be able to

establish programs of excavation. The presentation of practical problems and cases of work allows the students to contact with reality.

#### **4. MAIN BIBLIOGRAPHY**

##### **Compulsory:**

Eurocode 7 (ENV 1997-1:2004). "Geotechnical Design. Part 1: General rules". CEN, Brussels.

Fernandes, M. M. (1990). "Estruturas de Suporte de Terras", FEUP.

Fernandes, M.M. (2011). "Mecânica dos Solos: Introdução à Engenharia Geotécnica – Vol 2", Edições FEUP. ISBN: 978-972-752-136-4.

##### **Recommended:**

Braja, M. Das (1998). "Principles of Geotechnical Engineering". 4<sup>th</sup> Ed, PWS Publishing Company, Boston.

Ian Smith (2006). "Smith's Elements of Soil Mechanics". Wiley-Blackwell, ISBN 978-1-4051-3370-8.

Malcolm Puller (1996). "Deep Excavations - A Practical Manual". Thomas Telford.

#### **5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)**

Theoretical-practical teaching: exposure of topic programs, whenever possible using active learning methods, illustrated by cases, examples and problems.

Practical teaching: answering questions about the solution of problems and proposed applied works.

Tutorials: personal guidance sessions in small groups in the classroom to conduct the learning process, including guiding the work of the individual student and answer questions.

Presentation of case works to contact with the reality of the design and sizing of retaining structures.

Preparation of group work relating to different types of containment structures.

Evaluation:

Different times of evaluation are formed by two parts:

- Written test (70 %)

- Group work (30 %)

Students who do not deliver the work group are assessed by written examination (100 %).

Students who do not get approval, may submit to examination at the regular season or at the special season, which may include in optative mood, the classification of group work.

#### **6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES**

In order to achieve the objectives of this subject are taught theoretical knowledge about the fundamentals that explain the behaviour of soils (15 h), in addition to a strong practical component where the student applies a set of tools that allows to predict and evaluate the behaviour of the soils (30h), while the students are subject to great laboratory activity (15 h) in order to support the theoretical knowledge and prepare them for future professional activity.

**7. ATTENDANCE**

Without any restriction.

**8. CONTACTS AND OFFICE**

Geotechnical Laboratory / [crod@ipg](mailto:crod@ipg)

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Subject area coordinator  
Civil Engineering  
(José Carlos Almeida)

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Teacher  
(Carlos Rodrigues)