# Geotechnical Infrastructure (250MEG009)

## General Information

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|---|---|
| **School** | ETSECCPB |
| **Departments** | Departament d'Enginyeria Civil i Ambiental (DECA) |
| **Credits** | 5.0 ECTS |
| **Programs** | MÀSTER UNIVERSITARI EN ENGINYERIA GEOTÈCNICA (pla 2025) |
| **Course** | 2025/26 |

## Main teaching language at each group

- Group 10Q1 Spanish (Q1)

## Faculty

Responsible Faculty: Jean Vaunat
Faculty: Marcos Arroyo Alvarez De Toledo, Jean Vaunat

## Objectives of Education

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
To characterize the geological environment and its interaction with civil works.
To interpret laboratory tests and field observations so as to identify the mechanisms responsible for soil response. To propose testing programmes.
To formulate and implement Finite Element and Finite Differences numerical models with the objective to analyze the processes that govern ground response, to interpret field information and to predict soil response.
To analyze, discriminate and integrate geological and geotechnical information in studies and projects.
To apply the knowledge on soil and rock mechanics to the development of the study, design, construction and exploitation of foundations, excavations, embankments, tunnels and other constructions on or through the soils, regardless of their nature and state or the finality of the works under study (Specific competence of the specialties in Geotechnical Engineering and Earthquake Engineering and Geophysics).
To analyze, from the perspective of an expert, cases of failure in Geotechnical Engineering. To report the evidences, identify the mechanisms responsible for the failure and verify using back- analysis models. Eventually provide solutions to risk reduction. (Specific competence of the specialization in Geotechnical Engineering).
To realize studies of land management and urban spaces, including construction of tunnels and other underground infrastructures. (Specific competence of the specialization in Geotechnical Engineering).
To use, in a discriminate manner, commercial software for numerical calculations in order to design and eventually monitor geotechnical structures. (Specific competence of the specialization in Geotechnical Engineering).

* To apply limit analysis concepts to the calculation of limit load in soils.
* To interpret the behavior of soils with regards to critical state mechanics.
* To interpret the behavior of compacted soils with regards to the mechanics of unsaturated soils.
* To suggest a geotechnical field survey campaign.
* To suggest a laboratory research program.
* To critically analyze laboratory and field test results and to obtain soil parameters.
* To calculate shallow and deep foundations.
* To calculate earth contention structures.
* To calculate tunnels in rocks and soils.
* To calculate preloading settlements.
* To use numerical models to calculate soil-structure interaction problems.
* To analyze fracture cases from the point of view of an expert.

- Ground investigation.
- Shallow foundations.
- Deep foundations.
- Calculation of earth pressure.
- Rigid containment structures.
- Reinforced earth structures. Anchors. Bolts.
- Diaphragm walls.

# Total hours of student work

| | | Hours | Percentage |
|---|---|---|---|
| Supervised Learning | Large group | 45.0 h | 100.00 % |
| | Medium group | 0.0 h | 0.00 % |
| | Laboratory classes | 0.0 h | 0.00 % |
| | Guided Activities | 0.0 h | 0.00 % |
| Self Study | | 80.0 h | |

# Contents

## Introduction

Introduction to the course

## Site investigation

Preliminary documentation
Density and depth of investigation
Surface investigation
Deep investigation
Trenches and boreholes
Piezometric observations
Sampling
Soil properties and parameters
Laboratory tests

## In situ tests

Standard penetration test (SPT)
Cone penetration test
Dynamic penetration test
Vane test
Pressuremeter test
Plate load test
Seismic tests
Permeability tests
In situ testing exercises

## Shallow Foundations

Introduction
Bearing capacity
Settlements
Design criteria
Factor of safety against failure
Admissible settlements

Design of a shallow foundation empirical
Allowable pressure
In situ tests

### Deep foundations

Preliminaries
Classification
Methods of pile construction
Mechanisms of resistance of piles
Bearing capacity of an isolated pile
Tip resistance
Shaft resistance
Special cases: gravel, rock
Bearing capacity of a pile group
Settlements of a single pile
Settlements of a pile group
Piles subjected to lateral loads
Negative friction
Foundation exercises

### Test

### Calculation of earth pressures

Coefficient of earth pressure at rest
Rankine active and passive states
Limit equilibrium
Method of Coulomb
Additional earth pressures due to surcharges
Earth pressure exercises

### Gravity structures

General aspects
Gravity walls
Rockfill walls
Cantilever wall
Gravity structures exercises

### Reinforced earth

Reinforced Earth
Green Walls
Bolts
Anchors
Reinforced earth exercises

### Diaphragm walls

Introduction
Construction aspects
Distributions of pressure on diaphragm walls
Drainage around an excavation
Propping
Surface settlements
Diaphragm wall exercises

## Teaching Methodology

The course consists of 1,7 hours per week of classroom activity (large size group) and 0,7 hours weekly with half the students (medium size group).

The 1,7 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 0,7 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

# Grading Rules

*(*) The evaluation calendar and grading rules will be approved before the start of the course.*

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

# Test Rules

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

# Bibliography

## Basic


- Jimenez Salas, J.A.; De Justo Alpañes, J.L.; Serrano, A.A. Geotecnia y cimientos. Vol. 2: Mecánica del suelo y de las rocas. 2a ed. Madrid: Rueda, 1975-1981. ISBN 84-7207-003-4 (V.2).
- Jiménez Salas, J.A.; Justo Alpañes, J.L. Geotecnia y cimientos: v. 3: Cimentaciones, excavaciones y aplicaciones de la geotecnia. Partes 1 y 2. Madrid: Rueda, 1971-1980. ISBN 84-7207-017-4.
- Peck, R.B.; Hanson, W.E.; Thornburn, T.H. Ingeniería de cimentaciones. 2a ed. México: Limusa. Noriega, 1990. ISBN 968-18-1414-2.