

Italian code: ICAR/07 (old) – CEAR-05/A (new)

Credits: 9

Course: Foundations and retaining structures

Main language of instruction: Italian

Other language of instruction: English

Head instructor

Professor Giada Maria ROTISCIANI - giada.rotisciani@unicusano.it

Objectives

The course aims to provide students with the general concepts and principles needed for the analysis and design of the main geotechnical structures: retaining structures and foundations. The course is practical without neglecting the theoretical aspects. The main topics covered in the course are: i) the analysis of active and passive limit equilibrium conditions in a half-space and an embankment; ii) the design criteria for rigid and flexible retaining structures; iii) the design criteria for shallow foundations under service and ultimate conditions; and iv) the design criteria for deep foundations.

For successful participation in the course, it is necessary to have a basic knowledge of soil mechanics and hydraulics in addition to basics of mechanics of solids and structural engineering.

Course structure

The course consists of eight modules. The first module is dedicated to the analysis of active and passive limit equilibrium conditions in a half-space. The second module shows how the lateral earth pressure expressions change in the case of excavations of limited height. The third module presents a brief description of the main types of rigid retaining structures and the criteria for designing the most traditional ones. Following the same approach, the fourth module presents a comprehensive analysis of flexible retaining structures. The fifth module focuses on in-situ testing. The sixth and seventh are devoted to the analysis of the behaviour of shallow foundations under working and ultimate conditions respectively. Finally, the seventh module presents the design criteria for pile foundations.

The knowledge acquired in the theoretical lessons is applied in the "virtual classroom" forum through ten activities consisting of solving simple practical problems (e-tivity).

Competencies

A. Knowledge and understanding:

Starting from the basic principles of soil mechanics and geotechnics, the student will gain an in-depth knowledge of the main aspects of the behaviour of geotechnical structures such as retaining structures and foundations.

B. Applying knowledge and understanding:

The student will be able to apply the knowledge gained to the analysis and design of retaining structures, both rigid and flexible, and shallow and deep foundations.

C. Making judgements:

At the end of the course the student will be able to interpret and analyse the behaviour of the complex geotechnical systems such as those covered in the course.

D. Communication skills:

To acquire the technical and scientific language necessary to express clearly the technical knowledge acquired during the course and to interact with other experts in the discipline.

E. Learning skills:

The course provides the basic theoretical and practical concepts that will be useful in subsequent professional activity.

Syllabus

Subject 1 – Limit equilibrium states in a half-space (16 h)

Rankine theory: active and passive limit equilibrium stresses

Influence of cohesion on the earth pressure

Influence of the slope angle of the soil surface on the earth pressure

Effect of water table on the earth pressure

Subject 2 – Limit equilibrium states in an embankment (23 h)

Kinematics of the ideal wall

Coulomb theory for the calculation of earth pressure

Influence of friction angle on earth pressure

Influence of wall displacement on earth pressure



Subject 3 – Gravity retaining structures (23 h)

Introduction to the design of geotechnical structures: Italian Technical Standard for Construction

Earth pressure due to overburden

Earth pressure due to pore water pressure

Earth pressure due to earthquakes

Main types of retaining walls

Geotechnical design

Structural design

Subject 4 – Flexible retaining structures (23 h)

Main types of flexible retaining structures: steel sheet piles and reinforced concrete diaphragms

Stability of the excavation wall

Earth pressures

Influence of pore water pressure

Cantilever retaining walls

Anchored retaining walls

Stability of the excavation bottom

Excavation induced displacements

Anchored bulkhead

Subject 5 – In-situ tests (6 h)

Boreholes

Standard Penetration Tests (SPTs)

Cone Penetration Tests (CPTs)

Subject 6 – Shallow foundations: bearing capacity (23 h)

Failure mechanisms and ultimate bearing capacity

Terzaghi bearing capacity expression

Drained and undrained analysis

Subject 7 – Shallow foundations: working conditions (23 h)

Displacement analysis of shallow foundations in fine grained soils

Displacement analysis of shallow foundations in coarse-grained soils

Maximum allowable displacements

Calculation of internal forces and moments under working loads

Subject 8 – Deep foundations (23 h)

Axial bearing capacity of a single pile

Lateral bearing capacity of a single pile

Evaluation system and criteria

The exam consists of a written test, which normally includes 1-2 numerical exercises and 1 theoretical question on the main topics covered in the course.

During the written test, it is NOT allowed to use handouts, notes, texts or forms.

Activities are evaluated from 0 to 5 points, while 0-25 points are assigned to the written test.

Bibliography and resources

1. Materials to consult

The educational materials (lecture notes, slides and video lessons) are available in Italian on the Unicusano platform.

2. Recommended bibliography

Lancellotta R. (2008), "Geotechnical Engineering", Taylor & Francis Ed.

Viggiani C. (1999), "Foundations", Hevelius Ed.