INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Soil Mechanics and Foundations II			Field of study	Geotechnics		
Bachelor in	Civil Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9089-322-2104-00-22		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			27	26	4	-	-	-	-	3

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. Determine the shear strength of soils. Understand the differences between drained and undrained shear strength. Determine the type of shear test that best simulates field conditions.
2. Estimate failure stresses for soil. Evaluate possible soil stress states and failure if the loading on a geotechnical system were to change.
3. Understand and determine lateral earth pressures. Understand the force that lead to instability of earth retaining structures. Determine the stability of simple earth retaining structures.
4. Estimate the stability of slopes with simple geometry and geological features. Understand the forces and activities that provoke slope failures.
5. Understand the benefits and handicaps of the laboratory tests and in-situ tests. Have a notion of the more important in-situ tests.
6. 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.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Understand basic concepts of geology, continuous mechanics, stress and strain states.
2. Apply numerical, differential, integral, matrix and vector calculation.
3. Use computing tools, worksheets.

Course contents

Shear strength of soils. A critical state model to interpret soil behavior. Stability of earth retaining structures. Slope stability. In-situ tests and sampling. Bearing of capacity of soils and settlement of shallow foundations.

Course contents (extended version)

1. Shear strength of soils. A critical state model to interpret soil behavior.
   - Typical response of soils to shearing forces. Models for the shear strength of soils.
   - Coulomb's model. Other Model. Undrained and drained shear strength.
   - Laboratory tests to determine shear strength parameters.
   - Other laboratory devices to measure shear strength. Field test.
2. Stability of earth retaining structures.
   - Basic concepts on lateral earth pressures. Coulomb's earth pressure theory.
   - Rankine's lateral earth pressure for a sloping backfill and a sloping wall face.
   - Lateral earth pressure for a total stress analysis.
   - Application of lateral earth pressure to retaining walls.
   - Types of retaining walls and modes of failure. Stability of rigid retaining walls.
   - Mechanical stabilized earth walls.
3. Slope stability.
   - Some types of slopes failure. Some causes of slopes failure. Infinite slopes.
   - Two-dimensional slopes stability analyses. Rotational slope failures.
   - Method of Slices. Bishop's method. Application of the method of slices.
   - Stability of slopes with simple geometry.
4. In-situ tests and sampling.
   - Type of samples, procedures, equipments and caution in the making of samples for laboratory tests.
   - Benefits and handicaps of the laboratory tests and in-situ tests.
   - In-situ tests: Standard Penetration Test, Cone Penetration Test, Dinamic Probing, Field Van Test.
   - In-situ tests: Cross-hole Seismic Test, Plate Load Test, Self-boring Pressuremeter Test.
5. Bearing of capacity of soils and settlement of shallow foundations.
   - Collapse load using the limit equilibrium method. Bearing capacity equations.
   - Mat foundations. Bearing capacity of layered soils. Building codes bearing capacity values.
   - Settlements. Settlements calculations.
   - Determination of bearing capacity and settlement of coarse-grained soils from field tests.

Recommended reading

1. Mecânica dos Solos, Conceitos e Princípios Fundamentais Volume I, Manuel de Matos Fernandes, FEUP Edições.
2. Mecânica dos Solos, Introdução à Engenharia Geotécnica Volume II, Manuel de Matos Fernandes, FEUP Edições.
3. Introdução à Mecânica dos Solos, José Folques, LNEC – Lisboa.
4. Essentials of soil mechanics and foundations, David F. McCarthy, Prentice Hall.
5. Geotechnical engineering – principles and practices (fundamental), Donald P. Coduto, Prentice Hall.

Teaching and learning methods

Theoretical lectures for exposition the matter. Analysis and discussion of the matter exposed. Practical lessons to solve practical exercises. Classes in the laboratory, to see and perform laboratory tests. Group and individual study.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
   - Intermediate Written Test - 50% (Chapter 1 and 2. Theoretical - 7. 00 Values (minimum grade 2 Values); Practice - 13. 00 Values.)
   - Intermediate Written Test - 50% (Chapter 3, 4 and 5. Theoretical - 7. 00 Values (minimum grade 2 Values); Practice - 13. 00 Values.)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)

Assessment methods

- Final Written Exam - 100% (Chapter 1 to 5. Theoretical - 7. 00 Values (minimum grade 2 Values); Practice - 13. 00 Values.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

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11-10-2022	14-10-2022	24-10-2022