INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Soil Mechanics and Foundations I			Field of study	Geotechnics								
Bachelor in	Civil Engineering			School	School of Technology and Management								
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits	6.0						
Type	Semestral	Semester	2	Code	9089-322-1203-00-23								
Workload (hours)	162	Contact hours	T 27	TP 26	PL 4	TC -	S -	E -	OT -	O 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. Describe the formation and physical characteristics of soils. Plan a soils investigation. Determine the proportions of the main constituents in a soil.
2. Determine particle size distribution in a soil mass. Classify soils. Determine index properties of soils.
3. Calculate stresses in soils (assuming elastic behavior) from external loads. Determine stress states. Determine effective stresses.
4. Determine the rate of flow of water through soils and hydraulic conductivity of soil. Calculate flow ander and within earth structures.
5. Determine the stability of simple geotechnical systems subjected to two-dimensional flow of water.
6. Have a basic understanding of the consolidation of soils under vertical loads. nt.
7. Be able to calculate one-dimensional consolidation settlement and time rate of settleme
8. Determine maximum dry unit weight and optimum water content.

Prerequisites

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

Course contents

Composition of soils. Physical soil parameters. Classification schemes. Stresses, strains, and elastic deformation of soils. Flow of water through soils. One-dimensional consolidation settlement of fine-grained soils. Field compaction. Dry unit weight-water content relationship.

Course contents (extended version)

1. Composition of soils. Physical soil parameters. Classification schemes.
   - Soil formation. Soil types. Clay minerals. Soil fabric.
   - Comparison of coarse-grained and fine-grained soils for engineering use.
   - Characterization of soil based on particle size.
   - Physical states and index properties of fine-grained soils. Soil classification schemes.
2. Stresses, strains, and elastic deformation of soils.
   - Stresses and strains. Idealized stresses-strain response and yielding. Hooke's law.
   - Plane strain and axial symmetric conditions. Stress and strain states. Total and effective stresses.
   - The principle of effective stress. Stresses in soil from surface loads.
3. Flow of water through soils.
   - Definitions of key terms. Darcy's Law. Empirical relationship for k.
   - Flow parallel and normal to soil layers. Equivalent hydraulic conductivity.
   - Two-dimensional flow of water through porous media. Flownet sketching.
   - Interpretation of flownet. Flow through earth dams. Soil filtration.
4. One-dimensional consolidation settlement of fine-grained soils.
   - Instantaneous load. Consolidation under a constant load-primary consolidation. Secondary compression
   - Drainage path. Rate of consolidation. Effective stress changes under a constant load.
   - Void ration and settlement. Effects of vertical stresses on primary consolidation.
   - Primary consolidation parameters. Calculation of primary consolidation settlement.
   - One-dimensional consolidation theory. One-dimensional consolidation laboratory test.
   - Relationship between laboratory and field consolidation. Preconsolidation of soil using wick drains.
5. Field compaction. Dry unit weight-water content relationship.
   - Dry unit weight-water content relationship. Proctor compaction test. Zero air voids curve.
   - Importance of compaction. Compaction quality control.

Recommended reading

1. Mecânica dos Solos, Conceitos e Princípios Fundamentais Volume I, Manuel de Matos Fernandes, FEUP Edições.
2. Mecânica dos solos – conceitos fundamentais, Serviço de Geotecnia do LNEC – Lisboa.
3. Essentials of soil mechanics and foundations, David F. McCarthy, Prentice Hall.
4. Geotechnical engineering – principles and practices, Donald P. Coduto, Prentice Hall.
5. Principles of geotechnical engineering, Braja M. Das, PWS Publishing Company.

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 Values; Practice 13 Values.)
   - Final Written Exam - 50% (Chapter 3 to 5. Theoretical 7 Values; Practice 13 Values. Theoretical component, least 2 values.)
2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Chapter 1 to 5. Theoretical - 7. 00 Values (minimum grade of 2 Values); Practice - 13. 00 Values.)

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

António Miguel Verdelho Paula	Debora Rodrigues de Sousa Macanjo Ferreira	José Carlos Rufino Amaro
13-03-2024	14-03-2024	16-03-2024