MODULE DESCRIPTOR 2022/23

CL217 Soil Mechanics

Registrar: Dr Hamed Moghaddasi	**Taught To (Programme):** Civil Engineering Civil & Environmental Engineering	
Other Lecturers Involved: Dr Alessia Amabile	**Credit Weighting:** 20 credits	**Semester:** 1&2
Assumed Pre-requisites: CL133 Soils and Earthworks	**Compulsory**	**Academic Level:** Year 2

Class Format and Delivery (hours):

Lecture	Tutorial	Laboratory	Coursework	Project	Private Study	**Total**
32	26	10	14		118	200

Class Aim(s)

This class aims to introduce the governing principles of geotechnical engineering, in particular groundwater flow in soils, effective stress, consolidation and settlement analysis.

Learning Outcomes

On completion of the class the student is expected to be able to

LO1 Understand water flow in the ground and predict pore-water pressures under steady-state flow conditions.

LO2 Understand the concept of effective stress in saturated soils and characterise the soil stress state resulting from hydraulic and mechanical loading.

LO3 Understand the behaviour of soil during consolidation and predict pore-water pressures/settlements as a function of time.

LO4 Determine the stresses induced beneath shallow foundations and the resultant foundation settlements using elastic solutions and consolidation theory.

Syllabus

The class will teach the following:

Topic 1: Water flow in soils.
- Occurrence of water in soils
- Bernoulli's equation applied to soils
- Darcy's law for water flow
- Laboratory & field determination of hydraulic conductivity
- Water flow in homogenous & heterogeneous media
- Introduction to flow nets (graphical and numerical methods)
- Uplift pressure in geotechnical applications
- Seepage related failures
- Methods to control groundwater flow

Topic 2: Effective stress
- Principle of effective stress
- Effective stress under hydrostatic conditions
- Influence of seepage on effective stress
- Liquefaction and critical hydraulic gradient

Topic 3: Consolidation and Settlement Analysis.
- Consolidation settlements
- Pre-consolidation pressure and normal/overconsolidated states
- Oedometer test
- Laboratory determination of 1-D compressibility
- Laboratory determination of consolidation coefficient
- Theory of 1-D consolidation

Topic 4: Stresses and Settlements Beneath Shallow Foundations
- Stress, strain and stiffness definitions
- Stress distribution beneath shallow foundations
- Elastic methods for immediate settlement prediction
- Final settlements from consolidation theory

Assessment Criteria

For each of the Course Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1 Understand water flow in the ground and predict pore-water pressures under steady-state flow conditions.
C1 Calculate hydraulic conductivity from laboratory 1-D tests
C2 Draw hydraulic head and pore water pressure profiles under 1-D flow in layered soils
C3 Calculate hydraulic conductivity in layered soils
C4 Use graphical and numerical method (hand-drawn) to produce 2-D flow nets in homogenous soil and calculate seepage and pore-water pressures
C5 Use numerical method to generate a 2D flow net to calculate seepage and pore-water pressures

LO2 Understand the concept of effective stress in saturated soils and characterise the soil stress state resulting from hydraulic and mechanical loading
C1 Calculate total stress, pore water pressure and effective stress profiles under static water conditions
C2 Calculate effective stress in seepage conditions
C3 Understand and predict failures observed due to zero effective stress

LO3 Understand the behaviour of soil during consolidation and predict pore-water pressures/settlements as a function of time.
C1 Calculate degree of consolidation of clay deposit
C2 Calculate pore-water pressure evolution in a consolidating clay deposit
C3 Determine consolidation coefficient from oedometer testing
C4 Determine 1-D compressibility from oedometer testing
C5 Calculate consolidation and final settlements

LO4 Determine the stresses induced beneath shallow foundations and the resultant foundation settlements using elastic solutions and consolidation theory.
C1 Calculate vertical stresses under loaded areas of varying geometry
C2 Calculate immediate settlements under loaded areas using elastic theory

The standards set for each criterion per Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessments.

Principles of Assessment and Feedback (*https://www.strath.ac.uk/staff/policies/academic/*)

Please state briefly how these are incorporated in this module.

1. Timely, constructive, and supportive feedback is given to students to help students understand the extent to which they have fulfilled the assessment criteria and support future development of their work. Model answers for laboratory reports are reviewed in class so students can make comparisons against their own work.
2. All assessments are clearly related to the learning outcomes and assessment feedback is provided against clearly stated criteria.
3. Assessments and methods are clearly explained to students at the start of the course.
4. The effectiveness of the assessment and feedback methods are reviewed at the end of the course and any recommended changes are implemented in the next academic year.

Recommended Reading

Recommended Purchase:

Craig, R.F. & Knappett, J.A., Craig's Soil Mechanics, 8th Edn. (2012) Spon Press ISBN 0-415-32703-2.

or

Craig, R.F. (2005). *Soil Mechanics*, 7th edn., Spon Press ISBN 0-415-32703-2. Available online.

Recommended Reading:

Powrie, W. Soil Mechanics; Concepts and Applications, 2nd edn., (2004), Spon Press, ISBN 0-415-31156-X
Atkinson, John H Mechanics of Soils and Foundations, 2nd edition (2007). CRC Press, ISBN 9780415362566

PLEASE NOTE:
Students need to gain a summative mark of 40% to pass the module. Students who fail the module at the first attempt will be re-examined during the August diet. This re-examination will consist entirely of exam.

Resit Arrangements

Students who fail the module at the first attempt will need to resit each component that they failed. If a student has failed both components (S1 & S2), then they will need to resit two exams, one for S1 material and another exam for S2 material, each accounting for 50%. Students must achieve a mark of 40% overall in the resit to pass the module.

Approved

Programme Director Signature:
Date of Last Modifications: 20/09/2022

Assessment and Feedback Schedule

Class Code	CL217	Class Title	Soil Mechanics

Brief Description of Assessment

Laboratories:
CL217 Lab A: Hydraulic conductivity (2%)
CL217 Lab B: Seepage around a sheet pile wall (5%)
CL217 Lab C: Heaving next to a sheet pile wall (3%)
CL217 Lab D: Oedometer test (5%).

Coursework:
Cwk 1: Embankment design project (5%)

The laboratories A, B, C and D will be undertaken in groups. Laboratories A, B, and C will be conducted via pre-recorded videos which will be made available on MyPlace and the assignment will be completed in groups of 3. For Lab D in Semester 2, please see laboratory timetable for date and time of laboratories for each group.

Mini-tests: There will be 10 online mini-tests (MTs) (5 in in S1 and 5 in S2), each MT will be worth 2%.

Exams:
S1 Exam = 30%.
S2 Exam = 30%.

Indicate in the tables below the Hand-Out (H), Submission (S) and Feedback (F) dates for each lab report/coursework/project and the timing of each Exam/Class Test (E), (T). Include duration of exam in brackets (e.g. E (2hr)).

Semester 1

Assessment type (& title)	Los	Weight (%)	Individual / Group	WK1	Wk2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
MT 1		2	I	H	S										
MT 2		2	I		H	S									
CL217 Lab A		2	G			H	S		F						
CL217 Lab B		5	G				H		S			F			
MT 3		2	I						H		S				
MT 4		2	I								H	S			
MT 5		2	I									H	S		

CL217 Lab C		3	G									H	S	F
S1 Exam		30	I											E (2hr)

Semester 2

Assessment type (& title)	LOs	Weight (%)	Individual / Group	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
MT 6		2	I	MT											
MT 7		2	I		MT										
MT 8		2	I					MT							
CL217 Lab D		5	G			H			S			F			
CL217 Cwk 1		5	G							H		S		F	
MT 9		2	I								MT				
MT 10		2	I										MT		
S2 Exam		30	I												E (2hr)

.Mapping Module Learning Outcomes to AHEP

Module Learning Outcome	**Engineering Council AHEP competencies: Knowledge, Understanding and Ability**
LO1 Understand water flow in the ground and predict pore-water pressures under steady-state flow conditions.	• Understanding of engineering principles and the ability to apply them to analyse key engineering processes • Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques • Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action • Knowledge of characteristics of particular materials, equipment, processes, or products • Ability to apply relevant practical and laboratory skills
LO2 Understand the concept of effective stress in saturated soils and characterise the soil stress state resulting from hydraulic and mechanical loading.	• Understanding of engineering principles and the ability to apply them to analyse key engineering processes • Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques • Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action • Knowledge of characteristics of particular materials, equipment, processes, or products
LO3 Understand the behaviour of soil during consolidation and predict pore-water pressures/settlements as a function of time.	• Understanding of engineering principles and the ability to apply them to analyse key engineering processes • Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques • Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action • Knowledge of characteristics of particular materials, equipment, processes, or products • Ability to apply relevant practical and laboratory skills • Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate
LO4 Determine the stresses induced beneath shallow foundations and the resultant foundation settlements using elastic solutions and consolidation theory.	• Understanding of engineering principles and the ability to apply them to analyse key engineering processes • Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques • Ability to apply quantitative and computational methods in order to solve engineering problems and to implement appropriate action

JBM Programme Threads

Thread	Primary	Secondary	Contributory
Design	CL217 Cwk 1		
Health, Safety & Risk Assessment			CL217 Lab A, B, C, D
Sustainability		CL217 Cwk 1	
Maths for Engineers	All assessments		
Industrial Engagement			
Digital Technologies		Lab B & D.	