MODULE DESCRIPTOR 2019/20

CL217 Soil Mechanics

Registrar: Dr Grainne El Mountassir	**Taught To (Programme):** Civil Engineering Civil & Environmental Engineering	
Other Lecturers Involved: Dr Alessia Amabile Dr Arianna Gea Pagano	**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
- Darcy's law for water flow
- Laboratory & field determination of hydraulic conductivity
- Water flow in homogenous & heterogenous media
- Introduction to flow nets (graphical and numerical methods)
- Uplift pressure in geotechnical applications
- Seepage through embankments & 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.
- Theory of 1-D consolidation
- Oedometer test
- Laboratory determination of consolidation coefficient
- Laboratory determination of 1-D compressibility
- Consolidation settlements
- Pre-consolidation pressure and normal/overconsolidated states

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% / 50% ***(please delete as appropriate)*** **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 / coursework / viva** ***(please delete as appropriate).***

Resit Arrangements

Exam (100%)

Approved

Programme Director Signature:
Date of Last Modifications: 19/08/2019

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: Oedometer test (4%).

Coursework:

Cwk1: Seepage around a sheet pile wall (5%)
Cwk2 - Embankment design project (5%)

The laboratories and coursework are undertaken in groups of four students. See laboratory timetable for date and time of laboratories for each group.

Mini-tests: There will be 7 online mini-tests (MTs) (4 in in S1 and 3 in S2), each MT will be worth 2%.

Exams: There will be exam at the end of each Semester worth 35% each.

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 (2)).

Semester 1

Assessment type (& title)	LOs	Weight (%)	Individual / Group	WK0	Wk1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
MT 1		2	I	MT												
MT 2		2	I		MT											
CL217 Lab A		2	G			H	S			F						
CL217 Cwk 1		5	G					H			S			F		
MT 3		2	I								MT					
MT 4		2	I									MT				
S1 Exam		35	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 5		2	I	MT											
MT 6		2	I		MT										
CL217 Lab B		4	G				H(1)	H(2) S(1)	H(3), S(2)	S(3)				F	
CL217 Cwk 2		5	G							H		S			
MT 7		2	I										MT		
S2 Exam		35	I												E (2hr)