UNSW Course Outline

CVEN9513 Advanced Foundation Engineering - 2024

Published on the 30 Aug 2024

General Course Information

Course Code : CVEN9513
Year : 2024
Term : Term 3
Teaching Period : T3
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Civil and Environmental Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The course covers analysis and design of shallow foundations and limitations of methods, advanced analysis methods of single piles and pile groups, analysis and construction methods of sheet pile walls, anchored and strutted walls, cast in-situ piles, diaphragm walls, soil anchors

and nails. It will also cover the basics of geotechnical earthquake engineering, seismic design of foundations, and earth retaining structures. Also, issues relevant to the design of shallow foundations and retaining walls when interacting with unsaturated soils will be addressed. The course will also require students to carry out analysis and design through project-based learning.

Course Aims

To introduce students to the state of the art of analysis and design in foundation engineering. By the end of the course successful students will be able to apply theoretical, empirical and numerical analysis and design techniques to foundation engineering problems.

Project based learning for understanding the principles of:
Analysis and design of shallow foundations and limitations of methods,
Design of shallow foundations and retaining walls in unsaturated soils,
Advanced analysis methods of single piles and pile groups,
Analysis and construction methods of sheet pile walls, anchored and strutted walls, cast in-situ piles, diaphragm walls, soil anchors and nails,
Basics of geotechnical earthquake engineering, seismic design of foundations, and earth retaining structures.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Explain the strength and serviceability design aspects for shallow foundations.
CLO2 : Evaluate static designs of various earth retention systems for strength and serviceability aspects.
CLO3 : Perform advanced analysis of single piles and pile groups.
CLO4 : Explain the critical geotechnical earthquake engineering concepts related to seismic site response analysis.
CLO5 : Evaluate the liquefaction potential of a given site by applying soil mechanics principles and geotechnical earthquake engineering.
CLO6 : Evaluate the seismic performance of retaining walls using simplified calculations and complex non-linear time-history analyses.

Course Learning Outcomes	Assessment Item
CLO1 : Explain the strength and serviceability design aspects for shallow foundations.	• Assignment 1 • Final Exam
CLO2 : Evaluate static designs of various earth retention systems for strength and serviceability aspects.	• Assignment 2 • Final Exam
CLO3 : Perform advanced analysis of single piles and pile groups.	• Assignment 2 • Final Exam
CLO4 : Explain the critical geotechnical earthquake engineering concepts related to seismic site response analysis.	• Assignment 3 • Final Exam
CLO5 : Evaluate the liquefaction potential of a given site by applying soil mechanics principles and geotechnical earthquake engineering.	• Assignment 3 • Final Exam
CLO6 : Evaluate the seismic performance of retaining walls using simplified calculations and complex non-linear time-history analyses.	• Assignment 3 • Final Exam

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Assignment 1 Assessment Format: Individual	10%	Start Date: 24/09/2024 05:00 PM Due Date: 02/10/2024 05:00 PM Post Date: 24/09/2024 05:00 PM
Assignment 2 Assessment Format: Individual	30%	Start Date: 24/09/2024 05:00 PM Due Date: 27/10/2024 03:00 PM Post Date: 24/09/2024 05:00 PM
Assignment 3 Assessment Format: Individual	20%	Start Date: 28/10/2024 12:00 AM Due Date: 10/11/2024 05:00 PM Post Date: 24/09/2024 05:00 PM
Final Exam Assessment Format: Individual	40%	Start Date: During formal exam period Due Date: During formal exam period

Assessment Details

Assignment 1

Assessment Overview

Incorporating suction into a bearing capacity problem using Sigma/W. The assignment should be a maximum of 3 pages, showing the calculations performed, assumptions made, the software output and computed bearing capacities. It may contain handwritten sections or be typed. A marking rubric will be provided to students. Marks will be returned within a week.

Course Learning Outcomes

- CLO1 : Explain the strength and serviceability design aspects for shallow foundations.

Detailed Assessment Description

Please read the assignment statement in Moodle.

Assessment Length

7 Days

Submission notes

Online submission in Moodle.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

Assignment 2

Assessment Overview

Analyses and Design of Earth Retention Systems. The assignment submission should be no longer than 12 pages. Marks will be returned within 2 weeks.

Course Learning Outcomes

- CLO2 : Evaluate static designs of various earth retention systems for strength and serviceability aspects.
- CLO3 : Perform advanced analysis of single piles and pile groups.

Detailed Assessment Description

Please read the assignment statement in Moodle.

Assessment Length

21 Days

Submission notes

Online Submission in Moodle

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
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Assignment 3

Assessment Overview

Road widening works. The submission should be no longer than 6 pages (including the cover page), showing the calculations performed, assumptions made, the software output and reasonings behind the observations. It may contain handwritten sections or be typed. Marks will be returned within 2 weeks.

Course Learning Outcomes

- CLO4 : Explain the critical geotechnical earthquake engineering concepts related to seismic site response analysis.
- CLO5 : Evaluate the liquefaction potential of a given site by applying soil mechanics principles and geotechnical earthquake engineering.
- CLO6 : Evaluate the seismic performance of retaining walls using simplified calculations and complex non-linear time-history analyses.

Detailed Assessment Description

Please read the assignment statement in Moodle.

Assessment Length

14 Days

Submission notes

Online submission in Moodle.

Assignment submission Turnitin type

Not Applicable

Generative AI Permission Level

No Assistance

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Final Exam

Assessment Overview

2 hour final exam to be held during the final examination period. The exam will cover all material covered in the term.

Course Learning Outcomes

- CLO1 : Explain the strength and serviceability design aspects for shallow foundations.
- CLO2 : Evaluate static designs of various earth retention systems for strength and serviceability aspects.
- CLO3 : Perform advanced analysis of single piles and pile groups.
- CLO4 : Explain the critical geotechnical earthquake engineering concepts related to seismic site response analysis.
- CLO5 : Evaluate the liquefaction potential of a given site by applying soil mechanics principles and geotechnical earthquake engineering.
- CLO6 : Evaluate the seismic performance of retaining walls using simplified calculations and complex non-linear time-history analyses.

Detailed Assessment Description

Two hours open class notes exam in Inspera. Details will be provided during the course.

Assessment Length

2 Hrs

Assignment submission Turnitin type

Not Applicable

Hurdle rules

A mark of at least 40% in the final Inspera examination is required before the class work is included in the final mark.

Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.
For more information on Generative AI and permitted use please see here.

General Assessment Information

PG students who are onshore and reside more than 100km away from the UNSW Kensington campus can apply to sit the exam remotely.Please refer to the External Exam Policy (https://intranet.civeng.unsw.edu.au/external-exam-policy) for your eligibility. Applications must be submitted by Week 6 as late submissions will NOT be accepted.

For short courses, you are still required to attend in person for 5 days.

Grading Basis

Standard

Requirements to pass course

Total marks of at least 50% is required to pass the course.

A mark of at least 40% in the final examination is required before the class work is included in the final mark.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 2 : 16 September - 22 September	Lecture	18/9/2024 Bearing capacity of shallow foundations: conventional approaches, methods of analyses. Problems in bearing capacity of shallow foundations: strength & stiffness, irregular shapes, Ng, Nc, layered soils, settlements & consolidations. Shallow foundations in unsaturated soils: Soil suction and its incorporation into the effective stress and soil strength. Extension of bearing capacity theory. Knowledge gaps. Assignment 1 Introduction and Software Analysis: Incorporating suction into a bearingcapacity problem using Sigma/W.
	Lecture	19/09/2024 Analyses and Design of Earth Retaining Structures Sheet pile walls: construction, cantilever walls designed by UK method, USA method, and King (1995) and Day (1999) method; anchored walls. Case study – Cutter soil mix (CSM) walls in sand: fundamental concepts and innovations through fibre reinforcement. Anchored and strutted walls, diaphragm walls, soil anchors and nails: construction, earth pressure envelop, design and analysis of walls and soil anchors. Case study – Nicoll Highway collapse Retaining walls in unsaturated soils: Extension of earth pressure theory. Knowledge gaps. Assignment 2 Introduction.
	Lecture	20/09/2024 Advanced Analyses of Piles and Pile Group Advanced analysis of single pile: load-settlement analysis of single pile by load transfer method, analytical method of Randolph and Wroth, elastic method. Introduction to numerical discretization of load transfer method. Influence factor method for pile group. Cast in-situ piles: construction, ultimate bearing capacity and allowable bearing capacity based on tolerable settlement of bored cast in-situ piles.
Week 3 : 23 September - 29 September	Lecture	23/09/2024 Geotechnical earthquake engineering – Introduction Theory of continental drift and plate tectonics, fault mechanisms, quantification of earthquake size, waves in a semi-infinite body, concept of damping, modal analysis, constitutive behaviour of cyclic loaded soils, liquefaction. Seismic design of footings and piles. Seismic bearing capacity of shallow foundation, Settlement of foundation in liquefied ground, total and differential settlement of shallow foundation. Seismic performance of pile foundation, failure mechanism of pile supported structures, seismic performance of piles in liquefiable soils, seismic design of piles and design checks.
	Lecture	24/09/2024 Seismic design of retaining walls Concept of dynamic soil pressure, earthquake induced displacement of retaining walls, seismic design considerations for gravity and cantilever retaining walls. Finite element analyses of seismic actions on earth retaining structures. Introduction to Inspera Examination Platform Exam Tips and Consultation

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

The course will be delivered in Room 109, level 1 Civil Engineering Building H20, UNSW Kensington Campus.

PG students who are onshore and reside more than 100km away from the UNSW Kensington campus can apply to sit the exam remotely. Please refer to the External Exam Policy (https://intranet.civeng.unsw.edu.au/external-exam-policy) for your eligibility. Applications must be submitted by Week 6 as late submissions will NOT be accepted.

For short courses, you are still required to attend in person for 5 days.

Course Resources

Recommended Resources

It is not necessary to buy a text book as the notes provided are extensive and sufficient. These will include references to several books and numerous articles in the technical literature.

Completion of the assignments may require (if interrested) students to refer to these works.
Das Braja M, Principles of Foundation Engineering 8e SI, Cengage Learning.
Steven L. Kramer, Geotechnical Earthquake Engineering, Pearson Education.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Rohit Tiwari		Room 604, Level 6, School of Civil and Environmental Engineering (H20)	0293480182	Email to make appointment	No	Yes

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or

within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators
- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the

University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/ Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way

through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative

matters, please see the Nucleus: Student Hub. They are located inside the Library – first right as you enter the main library entrance. You can also contact them via http://unsw.to/webforms or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about the this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.